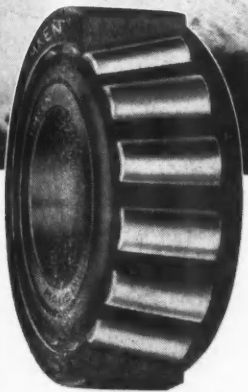


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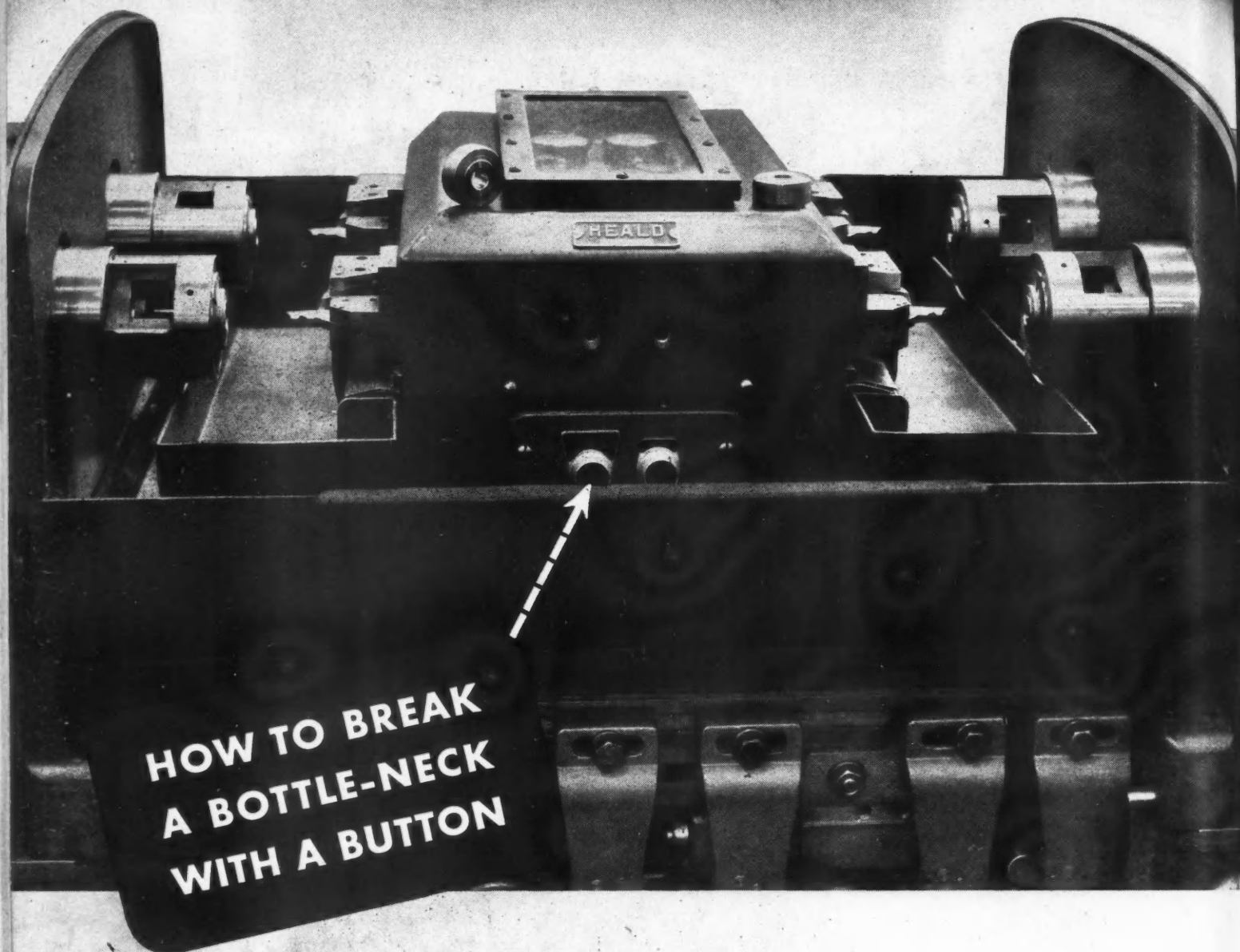


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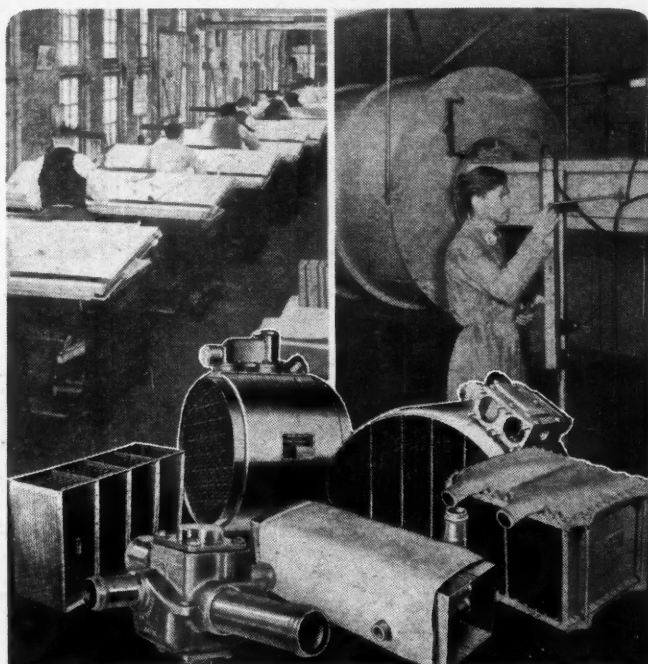
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Good, Hard Sense About Strikes

IT WOULD be well if whatever pseudo-economists, pretending altruists and demagogic leaders there may be within the higher councils of any rival labor organization would read, mark, learn and inwardly digest the substance of the major article published in the January issue of the American Federation of Labor's *Monthly Survey*. Written into that article is a lot of hard, plain commonsense which is particularly wholesome at this time. In support of that contention, and without further comment, the following quotations from the article are presented here as our editorial for this issue.—J. C.

"A strike should be the last resort, used only after genuine efforts at collective bargaining, conciliation and arbitration have failed. The reason for this is clear. Count the cost of a strike to the workers: Suppose the workers are earning an average wage of \$1.00 per hour. The company offers an increase of 12c to \$1.12, but the union turns down the offer because they think a government board may give them more. They go on strike and stay out for eight weeks. Each worker loses an average of \$358 (pay for eight weeks of 40 hours at \$1.12 an hour). At the end of that time the government board awards 18c, 6c more than the company offered. The company accepts the award and grants 18c, but it will take the workers nearly three years' work before this extra 6c will amount to enough to repay their loss. If, as seems more likely, the company refuses to accept the award and gives only 3c more (15c in all), then it will take the workers nearly six years of work before their extra 3c per hour will add up to the amount they lost by the strike. If the extra 3c or 6c breaks a price ceiling, workers may take losses they can never regain.

"If on the other hand, the workers had avoided the strike and used every means to build up a sound relationship of good will between their union and the company, and both sides had turned their attention to getting out production, they could have gained much more than the extra 3c or 6c in further wage increases. They could have saved their strike loss and won public good will by turning out the products other people were waiting to buy.

"Show your employer that you are seeking a fair and just settlement, satisfactory to both parties. Keep your contract. A broken contract is the mark of bad faith and irresponsibility.

"Know your industry and know your company. . . . Remember that your collective bargaining conference is the business of your union and your employer. The company does not want its information released to competitors. Don't injure your company's business.

"Remember that three groups—workers, consumers and management—should share the wealth created by American industry. This is the American way for—

(Turn to page 106, please)



Forget the Danger of
SURGE*
in Valve Springs

* **Surge**—the extra stresses which result when the vibration frequency of a rapidly oscillating spring coincides with its natural frequency.

To reduce the dangerous effects of surge, valve springs must be specially designed and carefully fabricated. Rigid tests are equally important, and Muehlhausen engineers use a machine of exclusive design for this purpose. Typical operating conditions are created, and springs are

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Aircraft Firms Diversify Products

Many Shifting to Consumer Goods

NEARLY one-half of the wartime aircraft manufacturers are now in production on consumer items ranging from radio cabinets to pre-fabricated houses. This shift in emphasis has been brought about by a combination of factors, all of which dictated the move. The precipitous contract cancellations on V-J Day literally halted the activities of many smaller firms and made tremendous inroads on the personnel and tempo of even the largest companies. The sudden reconversion problem thus generated caught many manufacturers without suitable peacetime models or the equipment for their quantity production. Whereas such prewar lightplane manufacturers as Piper, Aeronca and Taylorcraft were filling war contracts for types substantially similar to their commercial models, many others were producing highly diversified aeronautical equipment, sub-assemblies and complete airplanes wholly foreign to their peacetime activities. The reconversion problem for these latter companies was simply a question of whether to re-tool for a new airplane model or for a consumer item with a far greater market and requiring considerably less in tooling investment.

A second factor indicating such reconversion is the highly developed light metal, wood and plastic "know how" of the aircraft industry and its logical application to household and industrial uses. Many new and remarkable developments in welding, casting, shaping and fabrication of such useful materials as magnesium, aluminum, and alloy steels are now being brought to the consumer goods industries with resultant economies and greater utility to the home-maker.

The third, and possibly most important, factor is the tremendous market now existing for items missing from our economy during six years of war. This unparalleled demand, far greater than that for airplanes and aeronautical equipment (particularly in the

face of huge surplus stocks), seems entirely too good a bet for the smaller companies to overlook.

A brief review of the aircraft industry reveals the extent and diversity of the products now being offered. This article is intended for that purpose only and not to give a complete listing of companies and their new products.

An example of the complete conversion of an aircraft producer to non-aeronautical products is Interstate Aircraft and Engineering Corp., Los Angeles. This firm produced the highly successful Cadet two-place lightplane prior to the war. This design, as the L-6 communication type, was also built in quantity for the Army Air Forces during the war. Following V-J Day, Interstate disposed of the design, tooling and equipment to the Harlow Aircraft Co., Alhambra, Calif., and is now at work on soft drink dispensing machines, hermetic-type refrigerator compressors and one-cylinder, four-stroke gasoline engines in the $\frac{3}{4}$ to 6 hp class.

Timm Aircraft Corp., Van Nuys, Calif., wartime producers of Navy Aeromold trainers and Army troop gliders, is now at work on 5000 vacuum cleaners of a new design and \$1,250,000 worth of soft drink vending machines.

Laister-Kauffmann Aircraft Corp., St. Louis, which built hundreds of troop gliders for the Army Air Forces during the war as well as numerous experimental models, has converted to the manufacture of metal furniture and store fixtures, radio cabinets and a specialized line of toys and novelties.

Howard Aircraft Corp., Chicago, which delivered a series of ambulance and instrument training planes to the Navy during the war, has purchased the Electric Motor Corp., Racine, Wis., and plans to concentrate in that field with designs of fractional and high horsepower motors.

Beech Aircraft Corp., Wichita, has purchased Fuller Houses, Inc., designers of the well-known Dymaxion

By
**Robert
McLarren**

metal and plastic pre-fabricated house, and is in production on these units.

Aeroproducts Division of General Motors, Dayton, which delivered thousands of Aeroprop constant-speed high-horsepower propellers to the Army Air Forces for such planes as the Bell Airacobra and the North American Mustang, is now in production on washing machines for the Frigidaire Division of GM.

Kinner Motors, Inc., Glendale, Calif., wartime producers of 150-300 hp aircraft engines for the Army and Navy, has changed its name to Gladden Products Corp. and is concentrating on the design and manufacture of special hydraulic control equipment.

Allison Division of General Motors, designers of the famed Allison liquid-cooled engine of which thousands were delivered to the Army Air Forces during the war for such planes as the Lockheed Lightning, Bell Airacobra and Curtiss Warhawk, has purchased a large aluminum foundry in Bedford, Ind. To be known as the Allison-Bedford Foundry, the firm will produce aluminum castings and forgings for general industrial purposes.

Expanding its manufacturing activities, Republic Aviation Corp., Farmingdale, N. Y., has entered into a contract to purchase Aircooled Motors Corp., of Syracuse, builders of the Franklin airplane engine. The purchase price was \$1,500,000.

Of considerable interest is the partial conversion of the large aircraft firms and few of the best known in the nation have not developed a special line of products in the non-aeronautical field. Leading this group is the venerable, huge Curtiss-Wright Corp., which has created the unmistakable impression that it will shortly abandon the aircraft manufacturing field entirely. Bearing the oldest two names in the entire industry, Curtiss-Wright's reconversion problem has directed it into diversified fields. It has acquired Marquette Products Co., Cleveland, manufacturers of precision parts in the automotive field since 1920. Another acquisition is the L.G.S. Spring Clutch Corp., Indianapolis, producers of clutch mechanisms for all types of mechanical equipment. Having failed to receive orders for its well-known Commando transport plane, the firm's only postwar commercial aircraft offering, and having disposed of its \$5,000,000 wind tunnel and research laboratory to Cornell University, the fate of Curtiss-Wright has been further obscured by repeated and informed rumors of a merger with Lockheed Aircraft Corp.

Bell Aircraft Corp., Buffalo, has entered the rotary wing field and is in quantity production on the Bell Helicopter. The firm, however, is now at work on an order for \$1,000,000 worth of one-cylinder 5 hp engines for the Warren City Manufacturing Co., Warren, Ohio, manufacturers of the Rototiller, a farm implement combining the features of the plow and the

disk harrow. Bell is also preparing tooling for the manufacture of its own agricultural equipment, stoves and quick-freeze produce units.

Consolidated-Vultee Aircraft Corp. has experimented with numerous non-aeronautical products, best known of which was its streamlined, aluminum alloy bus, developed for Greyhound. The arrangements were cancelled subsequently but the firm is still continuing development of the type and definitely entered the automotive surface transportation field recently by acquiring controlling interest in ACF-Brill Motors Co., Philadelphia, manufacturers of motor buses and trolley coaches, and its wholly-owned subsidiary, Hall-Scott Motor Car Co., of Berkeley, Calif., which makes bus, marine and industrial engines. The two companies were owned by the American Car & Foundry Co., the cash transaction amounting to approximately \$7,500,000.

Largest reconversion activity of Consolidated Vultee at present is at its huge Nashville plant, where the well-known Vultee Vengeance dive-bomber and the

Lockheed Lightning were produced during the war. The plant is now undergoing \$2,000,000 worth of re-tooling in preparation for the production of gas and electric kitchen ranges. Known as the AVCO stove, it will be merchandised by The Aviation Corp. In addition to stoves, the plant will ultimately produce farm equipment and machinery and a new refrigerator design. Some time ago The Aviation Corp. acquired controlling interest in The Crosley Corp., which manufactures household appliances and radios, and New Idea, Inc., producers of farm equipment. Radio Station WLW at Cincinnati also is an AVCO activity.

Northrop Aircraft, Inc., Hawthorne, Calif. has added numerous activities not directly associated with aircraft. It has acquired the Joshua Hendy Iron Works, Sunnyvale, Calif. and, as the Northrop-Hendy Co., is developing various gas turbine projects for industrial and automotive uses. Northrop-Gaines, another new subsidiary, is a special development group which has produced a new-type aluminum hand truck, die-cast children's wagons and a radical aluminum hand truck of extreme lightness and great strength. Another Northrop acquisition is Salsbury Motors, Inc., Los Angeles, formerly Avion, Inc.

Northrop has gained particular fame with its prosthetic devices, best known of which is an artificial hand which most closely approximates the flexibility and strength of a human hand. This device consists of a strap looped around the opposite shoulder and a steel cable device by which the wearer can exert considerable clamping action on an object. Numerous other devices are undergoing rapid development in conjunction with the Veterans Administration and

(Turn to page 90, please)

WHILE it is evident that the many new products of these aircraft firms will continue in quantity production and development for the consumer field, the rapidly developing aircraft market, both here and abroad, should reach its flood within the next three years and the "aircraft" industry may, again, undergo "reconversion."

Ford Tells Why

IN AN address Feb. 8 before the Commonwealth Club at San Francisco, Henry Ford II, president of Ford Motor Co., discussed the manufacturing problems now confronting the Ford company. Part of his talk devoted to manufacturing costs is presented herewith:

While a solution of labor relations problems is of the greatest importance, it is only one of the major problems which face the Ford Motor Co., the automotive industry, our suppliers, and perhaps all industry. Shortly after V-J Day we made some calculations and announced that we hoped to be able to turn out 80,000 Ford cars and trucks by Christmas. Actually, instead of 80,000 cars and trucks we produced 30,000. Briefly, here are the great costs at which this production was achieved.

The Super Deluxe Tudor is the most popular of Ford cars. In 1941 a Super Deluxe Tudor Ford just rolling off the final assembly line represented a total manufacturing cost of \$512. It took 87 hours to build. Materials costs were \$304, direct labor costs were \$76 and overhead amounted to \$132. This same car rolling off the assembly line 12 months later—1942—represented a total manufacturing cost of \$681.

Why the increase? It took 15 more hours to assemble the 1942 car than the 1941. Direct labor costs instead of being \$76 were up to \$124. Materials costs had gone up from \$304 to \$343 and overhead from \$132 to \$225.

Ford production of pleasure cars had to halt for the war, so it is necessary to skip for any comparisons to November 1945—three months after V-J Day. Looking at the November 1945 cost records on the Super Deluxe Tudor Ford, when production figures were comparatively low, we find that the total manufacturing cost of this most popular of all Ford models added up to \$962—41 per cent more than in 1942 and 87 per cent more than in 1941. The car which had cost \$512 to build in 1941 and \$681 in 1942 cost \$962

It Costs 87%

More to

Build Cars

Washington Bureaucrats

Please Read This—

in 1945. The breakdown in relative working time is:

Instead of building the car in 87 hours, as we did in 1941, or in 102 hours, as we did in 1942, it took us 128 hours. That's an increase of 47 per cent over 1941. These figures, by the way, demonstrate pretty well why we have sought solid assurances of increased worker output from the Union. Our search for ever lower costs has no chance of success if this trend is not sharply reversed.

Labor costs, in short, rose to \$152—almost 100 per cent more than in 1941, and overhead costs increased to \$354 or 167 per cent more than in 1941. "Overhead" includes cost of plant maintenance during work stoppages.

The figures are merely manufacturing costs. They do not include the costs of sales and distribution, nor anything for profit.

Adding all these other factors, but allowing ourselves nothing for profit, our total costs were \$1041.26. In that same month—November, 1945—we were authorized by the Office of Price Administration to sell for \$728 this car which cost us—without profit or anything "to grow on"—\$1041.

P

ISTONS of internal combustion engines when under load, or when in service, are subjected to multiple stress and strain forces derived from comparatively high temperatures, and from torsional and vibratory influences caused by changing inertia conditions under the reciprocating action of moving masses in the gaseous as well as in the solid form. This combined force shall be called transitory inertia or vibrating inertia momentum because it represents the average or core of the amplitudes of vibrations of larger and smaller than zero capacity, and higher and lower than atmospheric gas pressure.

Under artificially created transitory inertia, in true coordination with stresses and strains in practice, a number of light metal alloy piston materials were tested, and the resulting diagrams prepared, so as to have a first-rate tool in hand for future application in the selection of piston materials useful in internal combustion engines. The piston metals were tested under application of heat for endurance load, under changing stress and strain and under overload. However, actual practice has proved to be the most reliable guide in the hands of engineers for determining the usefulness of piston alloys, and is especially true for light metal alloys. Test runs of this order are extremely time-consuming and expensive, and the number of newly-developed alloys is far too great to make it economically feasible to run them all. Fast and simple testing methods are necessary to safely select the most suit-

This article is a translation of a paper by Dr. Engineer K. Wellinger and Dr. Engineer G. Staehli published October, 1943 at the Public Material Research Institute of the State College, Stuttgart, Germany, under sponsorship of the Research Director of the Aircraft Ministry and the Commanding Officer of the German Air Force.

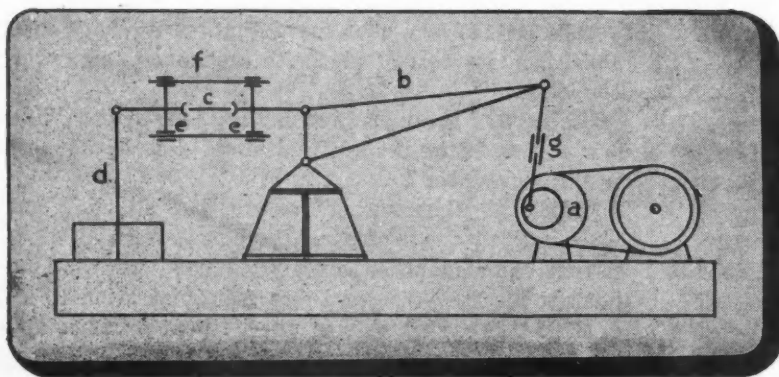


Fig. 1—Schematic diagram of the testing machine. (a) eccentric, (b) elbow lever, (c) test specimen, (d) recording spring, (e) chuck heads for fixtures, (f) parallel guide rail, (g) expansion sleeve coupling for connecting rod.

Reversed stress

Testing of Piston Materials

*at high temperatures
to determine their
usefulness*

able alloys. A few facts should tell the story about the properties and suitability of any particular alloy.

Previous attempts in this direction failed to provide the desired information. Generally, some properties of the alloy were derived from tests carried out under stationary circumstances or under reciprocating load only, and the conclusions drawn for the prospective behaviors at higher temperatures. For instance, the endurance load was determined from a time/elongation limit and time/breaking limit ratio, or by selecting one value for the lone average strength, usually the average bending strength as determined by the Wohler process, which is based on a number of reciprocating movements. In this connection, it should be pointed out that one single

value cannot and never will result in a reliable guide for predicting the behavior of a particular alloy. This may well lead to wrong conclusions, which, in fact, have been encountered in practice, of which various fractures and failures, deformations, etc. are evidence.

Transitory inertia tests were carried out on aluminum alloys, in order to obtain reliable data on the entire strength range of these light alloys, with reference to their usefulness within this range for piston application. It was necessary to carry out these tests under the limiting influences of possible breaks and unacceptable deformations because only by use of those diagrams which are taken from the first stages of fracturing and of deforming yield can behavior of new alloys be predicted. Such diagrams were particularly valuable when alloys of good repute were tested as a comparable means of designation for the new alloys under test.

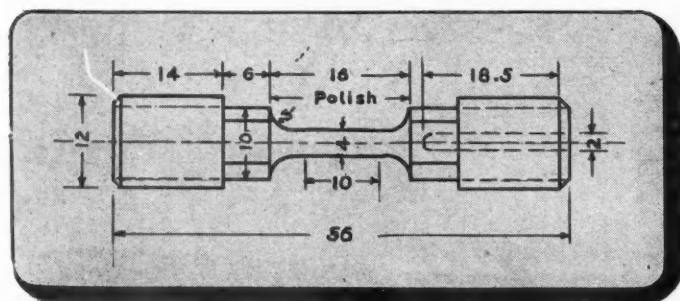


Fig. 2—The test specimen used. All dimensions given are in mm.

Fig. 1 illustrates a tension-compression vibration test machine, which is able to perform vibratory actions simultaneously under push and pull loads, as well as endurance/yield strength ratio under stationary load at high temperature ranges and between test loads of 500 kg per sq mm in tension and 500 kg per sq mm in compression.

Fig. 2 shows the small test specimen which is worked from piston stock in the unfinished form. Such small specimens necessitated the use of the fixture, *e*, shown in Figs. 1 and 3, which secures against excluding bending stress either during the arrange-

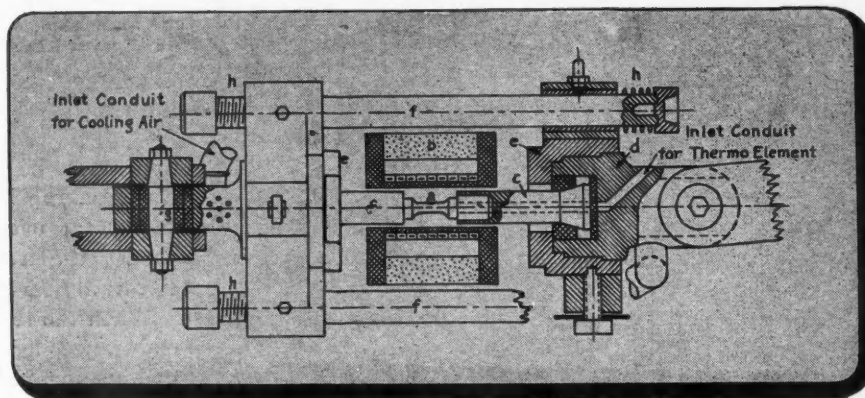


Fig. 3—Diagram showing the method used to lock the test specimen in the testing machine. (a) test specimen, (b) heater, (c) fixtures provided with bore for the insertion of thermo-element, (d) chuck head, (e) nuts with attached parallel guide sleeve, (f) guide bars, (g) rubber bearing, (h) springs.

ment of the test or during the vibratory treatment. The test specimen is heated by means of an electric air heater and the testing temperatures were approximately equal to the average temperatures encountered in actual practice. These were uniformly fixed as 200 C and 300 C.

Test Procedure

The ultimate goal for the tests was to establish comparative values which might serve as a rough estimate for the selection of piston alloys. This procedure also serves for alloys in all fields. Due to the great number of alloys which might be subjected to testing, the time intervals for testing are considerably shortened by adoption of this procedure. This reduction is based on earlier investigations and the factors explained in the following paragraphs.

The tensile-compressive breaking strength is determined from the limit frequency of 1000 vibrations or cycles per minute for 10 million cycles in all, applying the usual Wohler method. No need arose for determining the yield strength, because all of the tested aluminum alloys were devoid of any tendency to deform when under the influence of equal cycles in the positive and negative directions. There was no deformation of aluminum alloys even under the influence of heat.

The endurance load, which is the allowable limit value for the deformation resistance under stationary load, was determined on the same machine. The procedure followed, used a certain pulling force exerted by the shortened piston rod upon the heated test specimen. The deformations, resulting from the creep produced upon this specimen were measured and recorded by a load drop of the recording spring. This method of measuring elongation and deformation has the advantage of being extremely simple and seems to be the only possible way to measure data of this order on such a small sized specimen.

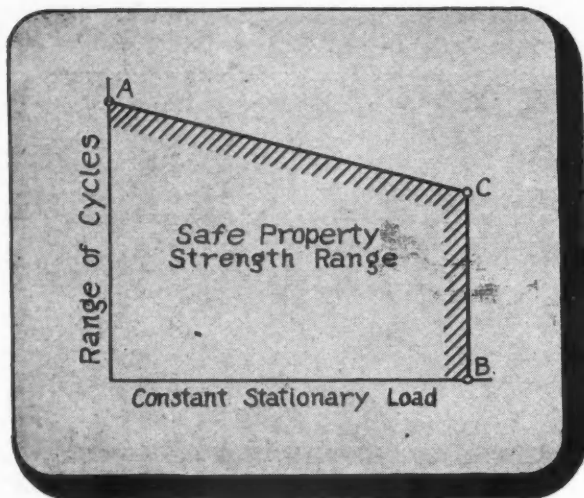


Fig. 4—Strength range diagram for a typical alloy. Point A is the limit for purely vibratory loads against breaking, point B is the limit for resistance to deformation under constant load and point C is the endurance-constant-load limit under vibratory load influence.

In our tests, however, this novel way of measuring deformation at first was postponed and the following endurance load determined. A starting load was accepted at which a specimen would suffer a permanent deformation of one per cent after 167 hours of exposure. This length of time under such a load represents the equivalent value for 10 million cycles at 1000 cpm. This unit of measurement resulted from the particular way of recording the elongation, because a final elongation of 0.2 per cent or 0.5 per cent did not give an accurate visible recording. The spring of the testing machine was comparatively elastic and an elongation of one per cent was found to represent a load reduction of about one kg per sq mm.

The third value to be found was the limit value for allowable overload, which is the value that is allowable above the endurance load without causing fractures at 10 million cycles of 1000 cpm, and without exceeding the one per cent elongation limit. Permanent deformations are recorded in the same way as the drop in load by observing the load reduction in relation to time. These data are plotted as Load-Reduction-Time-Elongation curves, which can be compared and computed with the Load-Reduction-Time-Elongation curves obtained from stationary loads, to form a new curve called the average creep strength. If in testing a series of alloys, the average breaking strength

appears to be lower than the average creep strength, the breaking load of the material is the determining factor for overload limit. If the relationship is opposite, the average creep strength is then the determining factor.

When the tensile-compressive breaking strength, the endurance load and the limit-overload are plotted, making the limit overload the ordinate and the tensile-compressive breaking strength the abscissa, as shown by points A, B and C in Fig. 4, the lines connecting points A, B and C represent the useful strength range of the alloy under test. (The line between A and B may be a curve instead of the straight line shown, as this is considered too far within the safety region.) This strength range of the alloy incloses the sum of

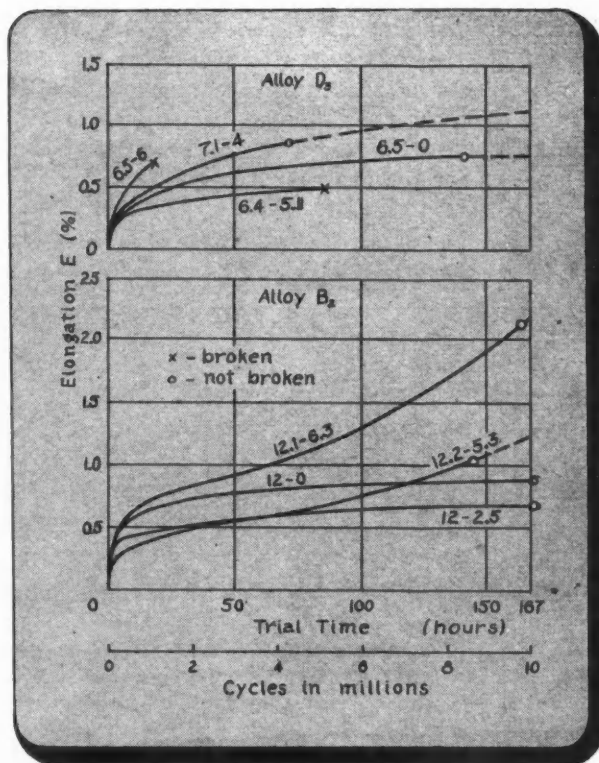


Fig. 6—(above) Comparison of the Reduction-Load-Time Elongation curves for alloys B₂ and D₂ at 200 C, under stationary and changing load. The ratios on the curves are constant load vibratory load, and are computed in kg per mm².

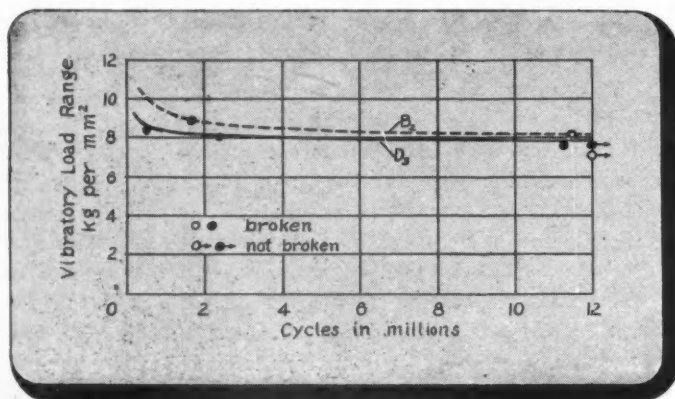


Fig. 5—(Left) Wohler curves of alloys B₂ and D₂ at 200 C.

the stress and strain and other influences, which will not lead to a fracture, or deformation of over one per cent in the alloy employed. This diagram, therefore, serves as a guide for selecting a suitable piston alloy. The alloys tested by this method are shown in Table I.

Test Results

Figs. 5, 6 and 7 illustrate how the simplified strength curves at 200 C have been obtained for piston alloys D₁ and B₁. Fig. 5 shows a zero condition for C of Fig. 4 according to Wohler curves for both alloys. Fig. 6 shows the curves resulting from the load reduction comparison of Load-Reduction-Time-Elongation curves under stationary and changing load.

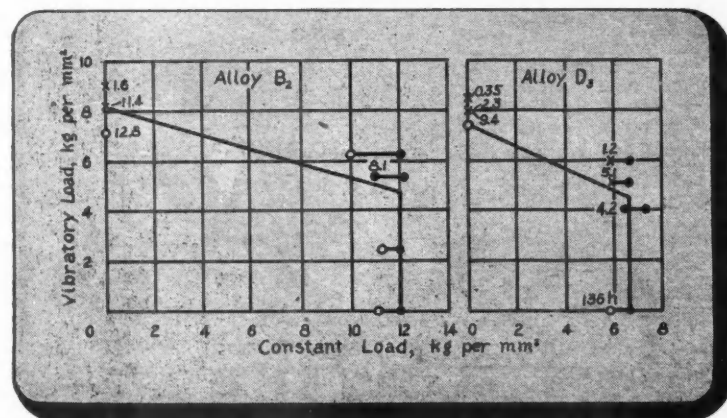


Fig. 7—Endurance load diagrams of the alloys B₁ and D₁ at 200 C, showing the breaking and creep behavior of the alloys. In the diagram, (o) is for unbroken specimens withstanding more than 10,000,000 cycles for 167 hours, (•) is for unbroken specimens withstanding shorter periodic runs, and (x) is for the broken specimens.

TABLE I—Tested Aluminum Alloys

Alloy No.	Alloy Group	Material State of Alloy	Temperature Tested deg C	Period Tested hr
A	Al-Cu-Ni-Mg	Wrought alloy	200 300	48 24
B ₁	Al-Si	Wrought alloy	200 300	48 24
B ₂	Al-Si	Special cast alloy	200	48
B ₃	Al-Si	Wrought alloy	200 200	48 100
C ₁	Al-Mg	Wrought alloy	200 300	1 1
C ₂	Al-Mg	Die casting	200 300	1 1
D ₁	Al-Mg-Fe-Cu	Wrought alloy	200 300	48 24
D ₂	Al-Mg-Fe-Cu	Wrought alloy	200 300	48 24

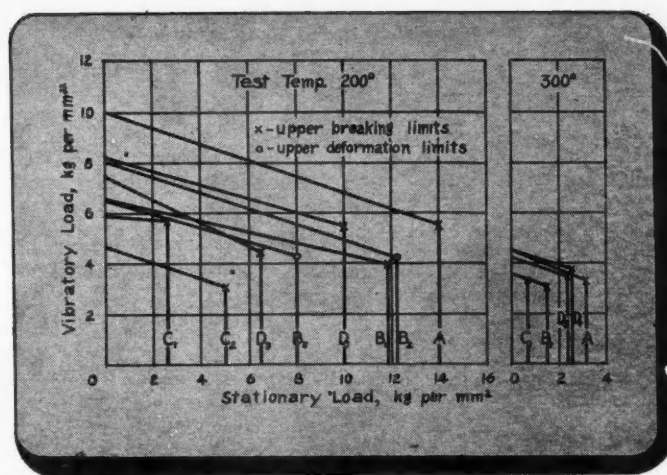


Fig. 8—Strength diagrams of aluminum alloys at 200 C and 300 C.

Fig. 7 shows endurance load diagrams coordinately resulting from Fig. 4, which make the breaking and creep behavior of the alloys visible. Test specimens which broke during the period of testing are designated by crosses, unbroken specimens or prematurely removed specimens are designated by a circle. The number of cycles or the time periods for the tests under stationary load are marked only in the cases where the recorded values were too low or higher than the curves. In overload limit determinations, the values are recorded at the start and end of the test and connected by a line whose length is the direct resultant for the test-and-elongation rate, which can be derived from the corresponding time-elongation curves.

A comparison of the Load-Reduction-Time-Elongation curves under stationary and changing load, as in Fig. 6, shows that in the case of superimposed reciprocating load, the curves follow paths which are lower than the curves obtained from stationary load. It is thought that the cause of this phenomenon might be a strain hardening influence upon the alloy material resulting from the reciprocations. In alloy B₁ the average breaking strength is higher than the required average creep strength, which provides for a limit due to the oversized elongation, but in alloy D₁ the opposite is observed. Therefore, the limit of reciprocating action against breaking, according to the Wohler method, must be reduced.

Fig. 8 illustrates strength diagrams of other alloys from Table I for temperature ranges of 200 C and 300 C. It can be seen that such a diagrammatical comparison is capable of supplying reliable information regarding the behavior of the alloys. If the values for the average strengths are compared, it can be seen that unexpected and false conclusions may be drawn. This is obvious if one tries to compute the overload

(Turn to page 66, please)

Design and Tooling



The FR-1 Fireball in flight. Note the forward position of the pilot's enclosure

RATED as one of the Navy's fastest and most versatile fighter planes, the Ryan FR-1 Fireball, powered by a radial piston-type engine and a gas turbine jet unit, was ready for combat service when the war ended. It has a wing span of 40 ft, length of 32.08 ft, and a gross weight of 9862 lb.

This airplane employs a high-speed, low drag, laminar flow type of air foil with dihedral in the outer panels only. This wing is very light, strong and torsionally stiff. The skin stringer combinations have been designed with buckling loads close to the yield loads so that a smooth surface would be available under all normal flight conditions. The control surfaces are all balanced statically, dynamically and aerodynamically allowing the Fireball to be maneuvered at high speeds with very small control forces. Another factor which contributes to the plane's maneuverability is the distribution of weight which concentrates the mass of the airplane closer to the center of gravity than in most craft.

The ailerons can be fully deflected at maximum speed to provide the Fireball with exceptional rolling characteristics. The plane has been designed to withstand the effects of compressibility and the latest design criteria have been incorporated to eliminate flutter at top speed.

The basic design problem was one of how to design what is probably the most compact airplane which has ever flown. The most careful consideration was given to the arrangement of the major structural members of the plane in the early stages of design. With a weight limit well below that of most fighters to meet, and two engines plus their fuel to accommodate the design work was exacting. The most desirable aerodynamic configuration was obtained by placing the engine in the nose and the jet unit in the aft sec-

tion of the fuselage.

Every possible effort was used to reduce the total structural weight of the plane without sacrificing any performance and still provide for good maintenance. The Fireball is constructed of high-strength, post-aged aluminum alloy. The difficulty in dimpling this extra hard metal was solved by a hot dimpling process and a specially designed dimpling tool.

In order to keep weight down to a minimum, several innovations were employed in the fabrication. An unusual type of structural configuration, previously used for vertical fins in one or two other planes, was developed further and used in the design of the outer wing panels and horizontal stabilizer. This is a single-spar, true monocoque, shell-type structure in which all of the bending stresses are carried by the single spar, all torsion is carried by the skin and the other components (ribs) of the structure serve only to support the skin contour to resist buckling. This type of structure is lighter and has a higher strength-weight efficiency than any similar structure of a comparable airplane.

Weight was reduced in the design of the nacelle and cowling by making the cowling a two-piece structure in which all of the principal loads are carried in hoop tension. This design provides the greatest utilization of material for load-bearing purposes and, therefore, permits the use of the lightest possible gauge of metal. The nacelle structure usually represents from three to four per cent of the gross weight of an airplane. In the Fireball, the nacelle, including the engine mount, weighs 201 lb, or approximately two per cent of the gross weight.

By the most careful design, it was possible to obtain a tricycle-type landing gear in the Ryan fighter which actually weighs only 495 lb, or nearly 100 lb less

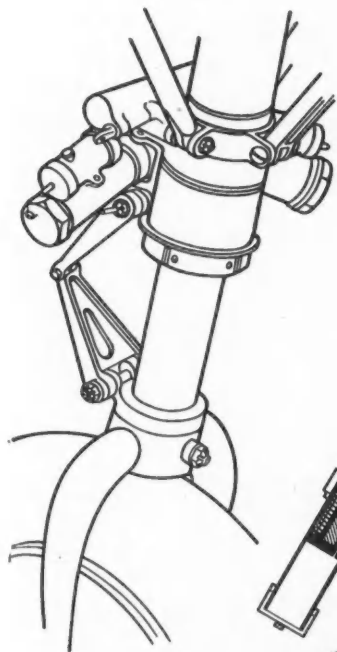
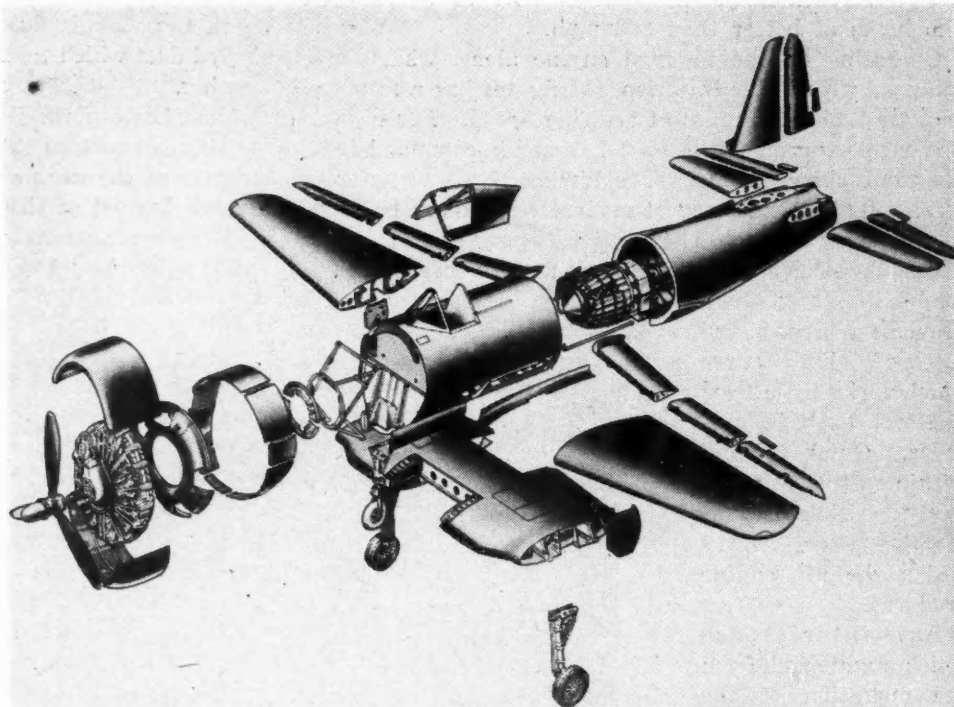
Aspects of the Ryan

Fireball Fighter

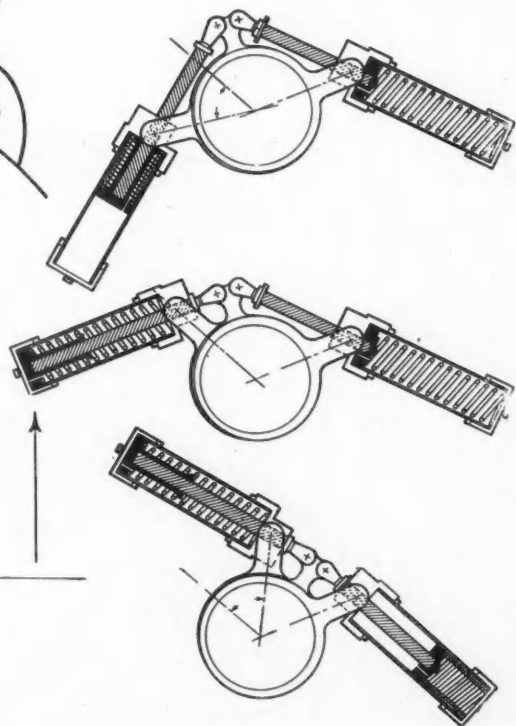
By Ben T. Salmon,

Chief Engineer,
Ryan Aeronautical Co.

Assembly break-
down of the FR-1
airplane



Line drawing
of nose wheel
gear and sec-
tional view of
the hydraulic
shimmy damp-
er with which
it is equipped



than the lightest conventional type gear on any fighter of comparable gross weight. The Fireball's landing gear comprises only 5.5 per cent of the gross weight of the plane instead of the seven to nine per cent in other fighter planes.

Further evidence of the saving of weight is the fact that the entire engine installation for the gas turbine jet engine, including the duct system, tail pipe and accessories adds only 150 lb to the weight of the bare engine.

A generous use of lightweight magnesium was made in the Fireball. The landing gear wheels are made of die cast, heat-treated magnesium. All of the skin aft of the hinge line on the flaps, ailerons and rudder are of magnesium. The cable control quadrant and most of the miscellaneous pulley brackets and fittings are made from the same light metal. Another weight saving feature arises from the fact that the fighter was the first new Navy plane in which exposed electrical

wiring was authorized. This departure, which had been inaugurated in the modification of several Navy planes, eliminates the added weight of conduit.

The installation of two engines in the Fireball—a Wright Cyclone, series C9HC, model 1820-72, radial type and a General Electric 1-16 gas turbine jet unit has many advantages. It allows the designer to locate the cockpit farther forward because of the more favorable fore and aft weight distribution. This gives the Fireball pilot an unusual range of vision. He can look straight ahead without being blinded by the nose or directly down over the leading edge of the wing to see a carrier deck throughout his entire approach. He has the safety of twin-engine performance, with either power plant capable of speeding him home at better than 300 mph.

Operating on the forward engine alone, which is equipped with water injection, the fighter has a range of more than 1500 miles at cruising speed. For high tactical performance the pilot has at his command in the gas turbine jet unit. The Wright Cyclone engine attains its best efficiency at moderate speeds and altitudes. The General Electric jet engine reaches its maximum efficiency at high speeds and altitudes. The combination of the two provides a speed and rate of climb curve which varies little from sea-level to high altitudes. Quick take-off within restricted areas is also possible because of the extra power which the aft engine produces.

Any interference which might result from the operation of the two engines where one is pulling the plane and the other pushing is eliminated by the use of the Curtiss fast-feathering, constant-speed propeller. The forward engine is equipped with an automatic power regulator, working through manifold pressure, which maintains any power at a given rpm that the pilot selects. The aft engine has a barometric type regulator which automatically maintains engine speed at all altitudes.

Both engine may be fed fuel from all fuel tanks, including the auxiliary drop tank. This flexibility allows the pilot to utilize his entire fuel supply in either engine depending upon the circumstances influencing his flight. An interesting and useful feature of the fuel system is the incorporation of a fuel transfer ar-

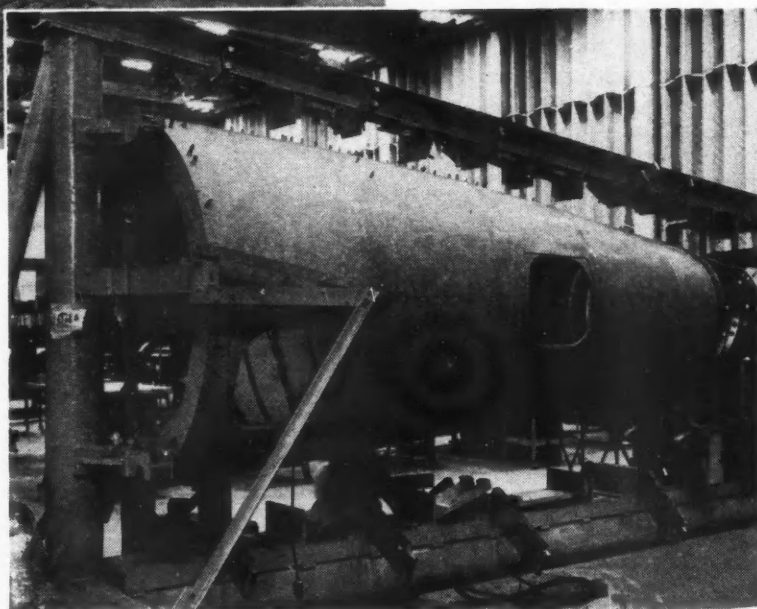
rangement which automatically feeds the fuel from the belly tank into the main tanks rather than to the engines. In most planes the belly tanks feed directly to the engines. This requires that the plane take off with its main fuel tanks because of safety restrictions. Therefore, the pilot who goes out on an operational flight always has partially depleted main fuel tanks when he drops his belly tank. The system is actuated by electric switches connected to fuel level gages so that the main tanks will not overflow.

The air induction system of the jet engine consists of two curved ducts of formed and riveted aluminum alloy leading back from the air intake scoops in the leading edges of the wing center panel on either side of the fuselage. They converge in the fuselage beneath the cockpit floor and form a single elliptical-shaped duct which then flares into a round, rolled-edge opening.

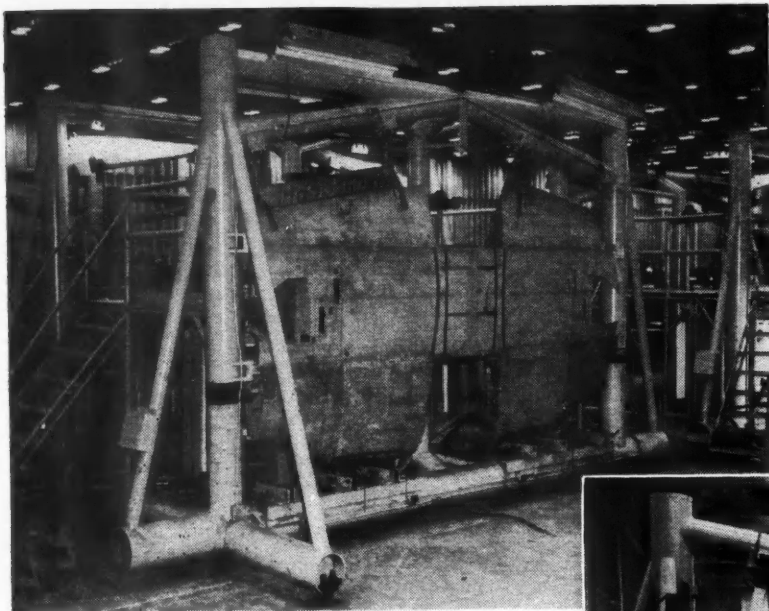
Just ahead of the jet unit an annular gap of $\frac{3}{8}$ in. opening is provided to permit a flow of air around the exterior of the engine and tail pipe and thence to the air exit located at the tail cone tip. This circulation of air protects the fuselage structure from the heat radiated by the jet engine and its tail pipe. In addition, the tail pipe is wrapped with alternate layers of corrugated stainless steel screen and aluminum foil in such a way as to provide dead air space and radiation insulation.



(Left) The all-metal elevator takes shape in an assembly jig

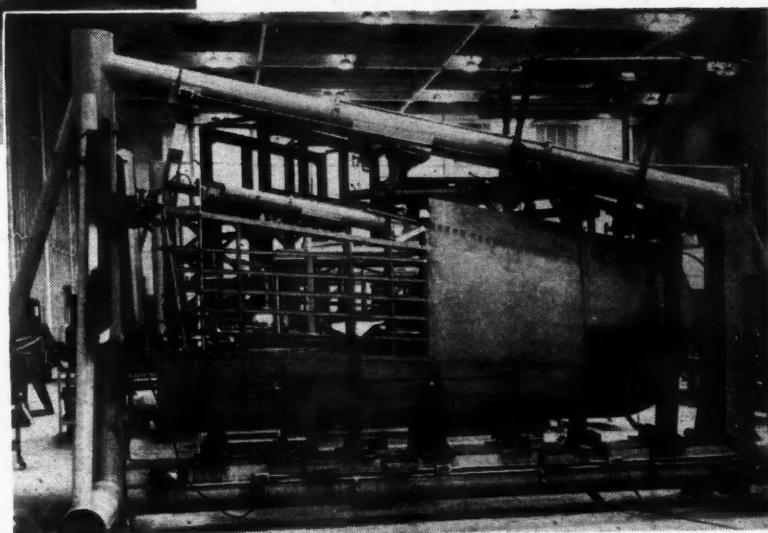


(Below) Fabrication of the quickly removable tail cone that houses the jet engine



(Left) Jig for assembling the center section of the Ryan Fireball

(Below) Outer wing panel being assembled in a heavy three point suspension fixture



The jet engine air induction system was worked out in three steps; first, a small transparent plastic scale model was made in which smoke could be introduced and observed; second, a small scale model was made and tested in the wind tunnel; and third, a full scale duct system was constructed and given complete tests with an engine running in the wind tunnel. No changes were necessary in the design of this full scale model.

Ready accessibility to both power plants is an outstanding feature of the Ryan Fireball. To make the aft engine available for quick replacement, Ryan designed the fuselage in two integral sections. A semi-monocoque tail cone is attached to the forward fuselage by four tension bolts and conical-seat type bushings just aft of the wing. A disconnect of the fuselage and the engine connections can be made in about 30 min. A monorail track is provided in the top of the aft fuselage section which allows the engine to be rolled out in a few minutes after the horizontal trunion pins and forward support strut have been removed.

Both engines are designed as packaged units, having quick-disconnect fittings on all controls and fuel lines at the fire walls. In combat, the special design of the fuselage, which is individually stressed in two components, makes quick replacement of the engines or tail section a welcome innovation.

The Fireball's landing gear is fully retractable tri-cycle-type with oleopneumatic shock struts to absorb impact. It is one of the first of its type to be incorporated into the design of a carrier-based Navy fighter and has a distinct superiority over the conventional gear. With it the Fireball pilot comes aboard a carrier in a level attitude which gives him an opportunity to see directly in front of the plane. The design of the nose wheel shock strut differs materially for carrier-based planes than those which are land-based because of the severe forward pitching moments imposed by arrested landings.

The landing gear may be actuated by any one of three distinct systems to provide a triple safety feature; the normal hydraulic system, the emergency hydraulic and the auxiliary hand pump system. The nose wheel is free-swiveling when the shock strut is compressed but is automatically self-centering by means of a cam in the oleo when the strut is extended. This insures its proper position in landing as well as during retraction.

Shimmying of the nose wheel is prevented by a Ryan-designed shimmy damper consisting of two double-acting hydraulic pistons which allow a slow turn of 55 deg in either direction but resist rapid movement. Most of the heart of the fuel and hydraulic systems have been located in the nose wheel well so that they are accessible to service crews without time-wasting removing of access doors.

A major problem in the design was to find room in the wing in which to retract the landing gear and maintain the armament inboard in the center section. It was decided to fold the landing gear main wheels outboard. This arrangement allows the guns and ammunition to be located inboard and permits complete accessibility to them with wings in either folded or locked position. The gun loading time is less than that required for refueling.

The problem of assembly tooling for FR-1 produc-

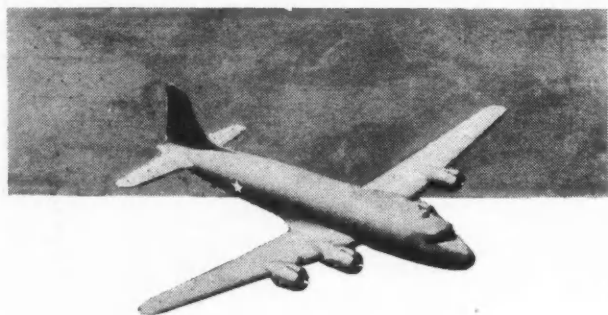
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Results of Flight Tests with

Detergent

Table I—Flight Tests—250 Hp Air Cooled Engines (600 Hr Operation)

Oil	Overall	Engine Deposit Ring Zone	Varnish	Ring Sticking
Oil 1.....	1.8	2.7	3.9	0
Oil 1 + 1.7 Volume % Additive A....	1.6	2.1	2.8	0



A BROAD program to evaluate heavy duty oil additives in aviation engine service was initiated by the Standard Oil Development Co., since it was felt that detergent type aviation oils would eventually be of considerable importance. Laboratory engine tests have indicated promise for detergent aviation oils, but it was considered necessary to have extensive flight test data to confirm further the degree of improvement obtained and also to determine if any adverse effects would materialize. In carrying out these flight tests, it was recognized that the improvement obtained with a detergent oil would be dependent on a number of factors, including the type of engine used, the type of service, and the quality of the mineral oil with which it was being compared.

In one series of tests, about 2500 hr of flight operation were obtained on a high quality mineral oil containing 1.7 per cent Additive A (a detergent-inhibitor additive) in low power output air cooled engines used in pilot training and operated for about 600 hr before overhaul with 50 and 100-hr oil drain periods. Satisfactory flight operation on the detergent oil was obtained and no foaming, unusual combustion chamber deposits, or spark plug difficulties were encountered. Complete examination of four engines that had operated on the detergent oil indicated a somewhat cleaner engine condition, particularly in the ring zone, than was obtained with the corresponding mineral oil in similar service. There was no significant difference as regards used oil condition between the used

This article is based on the paper, "The Application of Heavy Duty Additives to Aviation Oils," which was presented by the authors at the 1945 National Fuels & Lubricants Meeting of the Society of Automotive Engineers at Tulsa, Okla.

detergent oil and the used straight mineral oil. The result of these tests on 250 hp air cooled engines is given in Table I.

The extent of deposits formed in these engine tests is expressed in terms of an engine demerit rating system, where parts are rated on a scale ranging from 0-10. Perfectly clean parts are assigned a rating of 0, while a rating of 10 represents parts having the maximum obtainable amount of deposits. Ratings for individual engine parts are then combined into demerit ratings expressing mathematically the overall condition of the engine with respect to deposit formation.

In other flight tests excellent results were obtained at a certain pilot training station with a detergent oil, whereas at a corresponding station the use of a

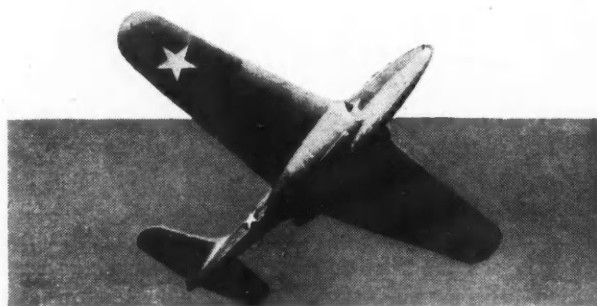


Table II—Effect of Additive A on Lubricating Oil Performance in Pilot Training Operations

Oil	Mineral Oil + 2.2% Additive	Mineral Oil
Ring Sticking, % of Top Rings Stuck or Tight....	0	54
Mechanical Condition		
Rings, Demerit Rating	0.9	1.4
Ring Taper Loss, %	28.0	40.0
Cylinder Condition, Demerit	0.4	0.6
Cylinder Corrosion, Demerit	0.7	1.1
% Rocker Arm Bearings Serviceable	93.0	59.0
Deposit Ratings		
Overall	2.0	2.2
Ring Zone	2.5	3.3
Varnish	3.3	4.1
Sludge	2.8	2.3

Type Aviation Engine Oils

By C. O. Tongberg and R. E. Ellis
and C. H. Baxley

Standard Oil Development Co.,
Intava, Inc.

Table III—Flight Tests on 450 Hp Air Cooled Engines (450 Hr Operation)

Oil	Average Engine Demerit Rating		Ring Sticking Number Stuck, Tight or Sluggish*
	Deposit	Mechanica	
Detergent Oil.....	1.5	0.4	1
Straight Mineral Oil.....	2.4	0.4	6

* Average per engine



straight mineral oil gave a relatively poor engine condition, particularly with respect to ring sticking. Comparison of the results obtained at these stations indicated that (1) the number of engines completing the normal 640-700 hr overhaul period was two to three times greater for the detergent oil compared to the straight mineral oil, (2) the number of engine overhauls due to piston, ring or cylinder condition was one-half to one-third less for the detergent oil compared to the mineral oil, and (3) the average flying time per overhauled engine was greater on the detergent than on the mineral oil. Examination of a group of engines after operation on these oils indicated that (1) whereas the detergent oil gave no ring sticking, 54 per cent of the top rings were stuck or tight after operation on the straight mineral oil, (2) the detergent oil gave a substantially better mechanical condition than the straight mineral oil, and (3) the detergent oil formed less ring zone and varnish deposits, but somewhat more sludge deposits, than the straight mineral oil. Pertinent data for these engines are tabulated in Table 2. The good performance obtained with the detergent oil is of considerable importance even though it is possible that differences in

maintenance and operating practices between the two training stations may have been a factor.

Very carefully controlled flight tests also were carried out on engines of somewhat higher power output (450 hp) operated for 450 hr without oil change in training operations. Four engines were operated on the compound oil (Oil 1 + Additive A) and a marked superiority in performance over the straight mineral oil previously used in these engines was obtained. There was a general reduction in deposit formation throughout all parts of the engine, as illustrated by the overall deposit demerits of 1.5 and 2.4 on the compounded oil and straight mineral oil, respectively. Carbon deposits were noticeably less in the ring zone and particularly on the sides of the rings and ring grooves. The average ring zone demerit rating for the four engines on the compounded oil was 2.0 compared to 2.7 for the straight mineral oil. Varnish deposits were considerably less on the piston skirts and noticeably less on the link and master rods, the average varnish demerits being 2.9 and 3.9 for the detergent and straight mineral oils, respectively. The link and

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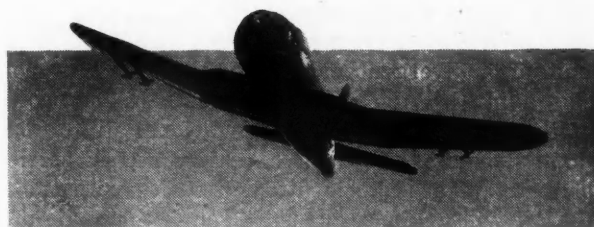


Table IV—Ring Sticking

Oil Used	Detergent Oil				Straight Mineral Oil			
	1	2	3	4	5	6	7	8
Engine Number.....	1	2	3	4	5	6	7	8
Number of Rings Stuck, Tight, or Sluggish...	0	2	1	0	4	6	5	9

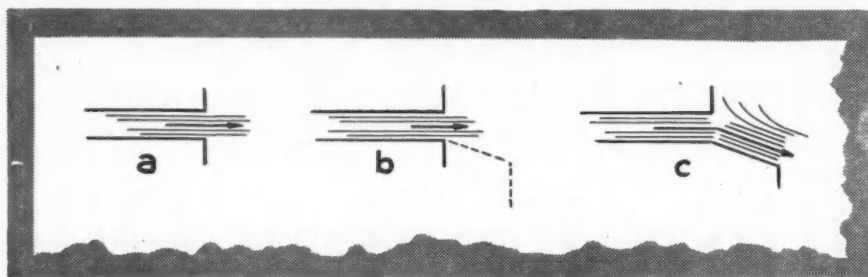


Fig. 1—Diagram of the basic phenomenon known as the induced flow effect.

Induced Air Flow for Engine

HENRI COANDA, a Roumanian engineer, during the past 10 years has been investigating a theory concerning the flow of fluids through special nozzles. By means of a venturi and special slots, an induced flow six to 20 times that of the working fluid has been established.

This system appears to offer certain possibilities where flow is to be induced, such as the use of exhaust gases to increase the flow of cooling air for automotive and aviation air cooled engines, as a thrust augmentor for jet engines, etc. The theory and operation of these nozzles are as follows:

When a stream of fluid is ejected at high speed from a slot fitted with one-half of a divergent passage, the stream is deflected from the axis of flow and subsequent turning can be achieved by making several such steps in series. In addition, the mass flow and the velocity of the stream are increased. Through the proper design of these steps, it is claimed to be possible to turn a fluid stream through 180 deg with the outer side of the passage open. In Fig. 1 (a), a mass of air is ejected from a slot at a given velocity. If half of a divergent passage is fitted to the slot, as shown in (b), the stream filaments follow the slope of this extension and induce additional air to join the main stream as shown in (c). If a second portion of a divergent passage is fitted in series with the first, the air will again be turned through the angle of this passage and still further air will be induced to flow with the main air stream. Optimum angles of the passages, as quoted by Coanda, are approximately 31 deg for the first, 28 deg for the second, 25 deg for a third, etc., decreasing by about 3 deg per stage.

A full range of pressures and slot sizes has not been explored, but sufficient tests were conducted to indicate performance and size limitations. A typical nozzle is shown in Fig. 2. The ratio of the thrust obtainable from this nozzle, to that obtained from a simple nozzle flowing the same mass flow and at the

same pressure as that of the primary fluid of the special nozzle, is the augmentation ratio or efficiency. The effect of the throat diameter on this ratio is shown in Fig. 3. It will be seen from these tests that nothing is to be gained through the use of the slotted nozzle

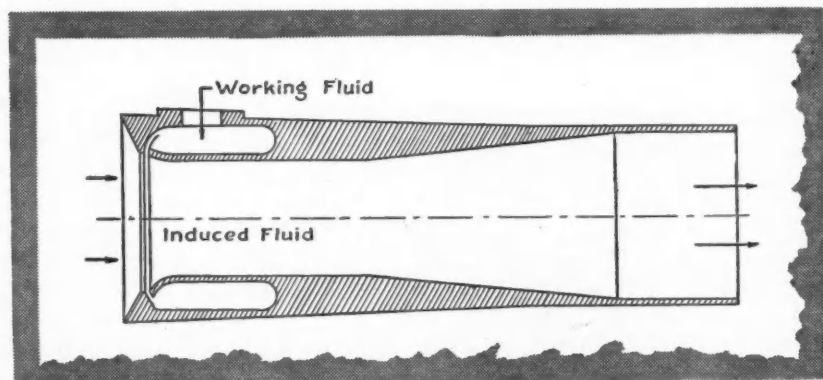


Fig. 2—Schematic diagram of the slotted nozzle, showing the flow of the working and induced fluids.

where thrust is desired, in sizes less than 80 mm in throat diameter. Also the effect diminishes with nozzle sizes greater than 200 mm throat diameter. There is an optimum slot size for every size throat and pressure ratio.

Actual test figures taken from laboratory reports are shown in Table I. The diameter of the nozzle in question was 130 mm and the augmentation ratio of 1.77 to 1 fits very well into the scale given from memory by M. Coanda:

Diam. of Nozzle (mm)	Augmentation
20	0.8
40	0.97
80	1.1
100	1.4
210	2.7 (peak value)
Larger nozzles	Diminishing

This article was prepared from a report entitled "The Coanda Effect," which was compiled by power plant engineers of the British Ministry of Aircraft Production and the United States Navy. The information was obtained by interrogation of M. Henri Coanda and members of his laboratory.

Cooling

These values are for the optimum flow through the nozzle, or optimum opening of the slot.

A practicable application of these nozzles has been made by the Usines Chasson, motor car radiator manufacturers in Asnieres, Paris. For some years this company had been endeavoring to design some new type of apparatus for cooling motor car engines, and Coanda suggested that the exhaust gases of the engine should be used as the working fluid in a slotted nozzle to draw cooling air through the radiator. They studied the problem and constructed a 150 mm nozzle, which when fitted with a 0.10 mm slot and using air as a working fluid at a pressure ratio of 1.0 to 1.5, induced a flow 20 times that of the working fluid. The by-pass ratio obtained in these tests varied with the size of the slot used. Increase of temperature of the working fluid seemed to give a slight increase to the augmentation effect, although there was some difficulty experienced in measuring mass flows, and the tests had been limited to a temperature of 140 C.

Actual tests were also carried out on a four-cylinder Citroen car engine and a flow of cooling air about six times the exhaust gas flow was obtained, even though the pulsating nature of the exhaust decreased

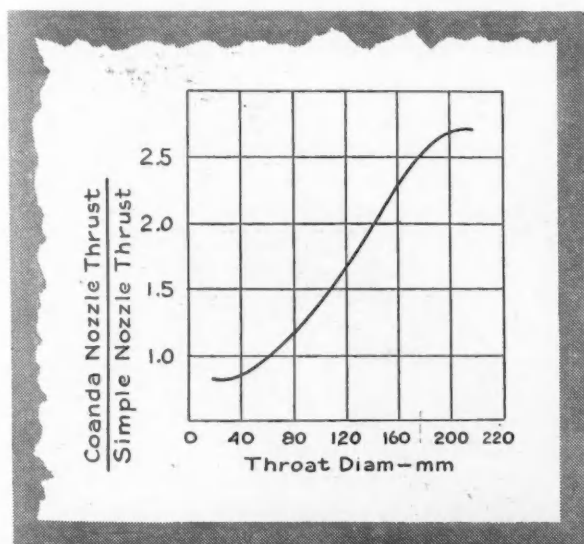


Fig. 3—Relationship of the augmentation ratio and the throat diameter for the slotted nozzles.

February 15, 1946

the effect to some extent. It was found that higher by-pass ratios were obtained with an inlet pressure to the slots of 1.5 to 2.0 atmospheres, and that with the small inlet pressure of exhaust gases, the by-pass ratio was about six to one.

Coanda also has built a rotary pump, the design of which is based upon the induced flow effect, for use in pumping gases and fluids. The pump has been tested by the Conservatoire des Arts et Metiers and it was reported to have produced a 99.8 per cent vacuum at an efficiency of 98 per cent. The pump can also be used as a compressor, but little work has been done along these lines. The principle of operation is

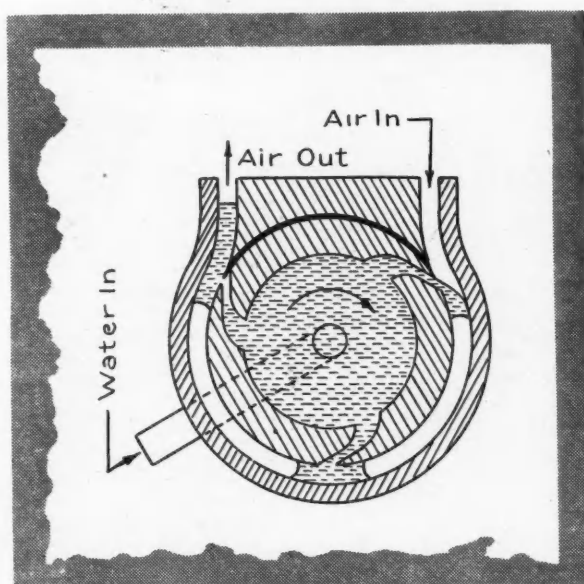


Fig. 4—Schematic diagram of the vacuum pump designed by M. Coanda, using water as the working fluid.

illustrated in Fig. 4. Basically it is a rotary piston pump using water, or some other fluid, for pistons. A head of water is carried on the pump rotor which is turned in the direction shown by the arrow. The rotor is cut with three equally spaced slots which connect the water chamber to the air chamber.

Table I—Laboratory Test Results for Slotted Nozzle (5.11 in. diam)

Expansion through special nozzle	
Pressure gage.....	14.2 psi
Nozzle slot.....	0.051 in. by 16.05 in.
Static thrust.....	21.7 lb.
Mass flow.....	0.388 lb per sec
Thrust.....	86 lb per lb air per sec
Expansion through simple nozzle	
Temperature.....	288 K (assumed)
Jet efficiency.....	95 per cent
Jet velocity.....	1020 ft per sec
Thrust.....	31.7 lb per lb air per sec
Coanda thrust.....	58.0 lb per lb air per sec
Simple jet thrust.....	31.7 lb per lb air per sec
Augmentation ratio.....	1.77 to 1

Milling with

THE inner wing spar caps of the Northrop P-61 "Black Widow" presented an interesting manufacturing problem. The front spar, which is the major structural member, has a box-type cross section. It consists of upper and lower spar caps, approximately 5.75 by 7.75 in. in cross section and 112 in. in length (see Fig. 1), connected by two heavy dural sheet webs.

At the start of our production, these caps were the largest extrusions made in this country. They are contour milled on Onsrud A-80-A spar mills, an extrusion of 405 lb to a spar cap of 128 lb. The extrusion

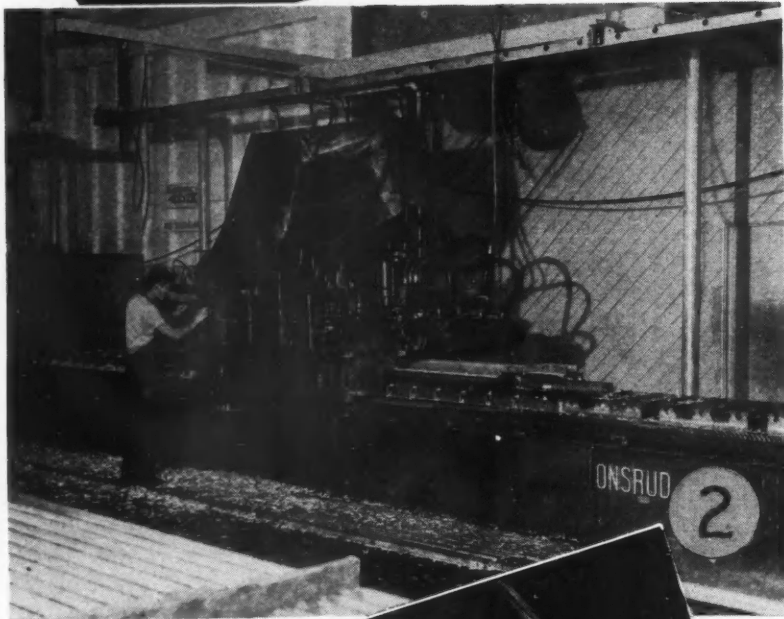
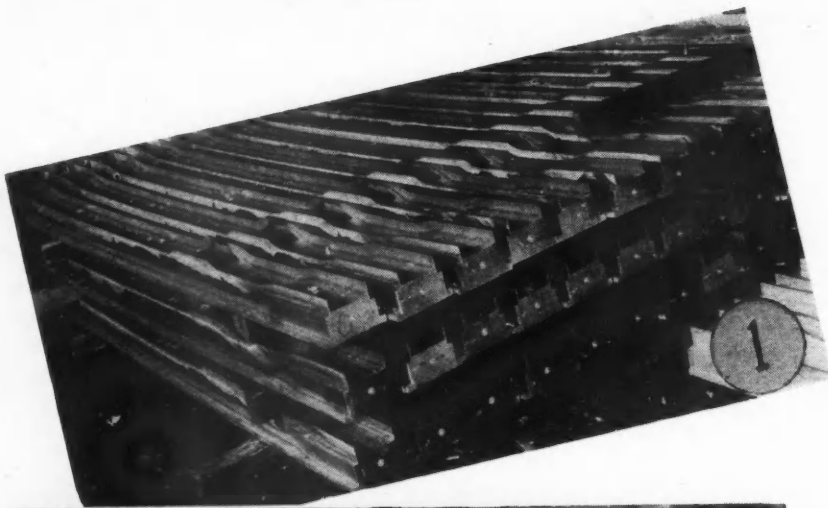


Fig. 1—Extrusions after first spar cap milling operation.

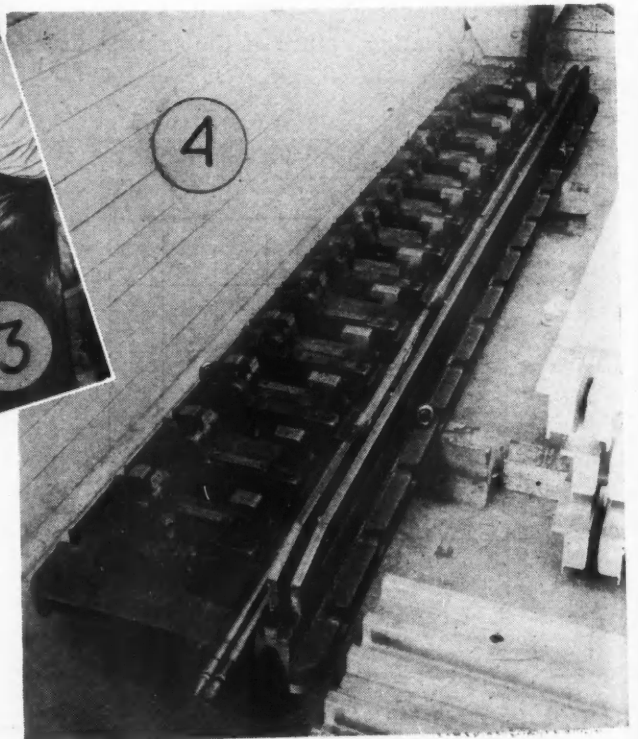
Fig. 2—Spar milling machine powered by two horizontal 100 hp motors and two vertical 30 hp motors.



Fig. 3—Closeup of carriage showing how roller is held

in close contact with form bar by air cylinder.

Fig. 4—Pneumatic spar cap mill fixture with form bars.



Large Spar Caps Positive Rake Cutters

ends are milled, drilled, and reamed on conventional equipment. About a year ago the material was changed from 14S-T to 75S-T with no effect on production.

The spar milling machine (Fig. 2) has a cast stationary bed with moving carriage supporting two horizontal 100 hp motors operating at 2900 rpm and two vertical 30 hp motors turning at 10,000 rpm. All four arbors are direct driven. The beds of the production machines are 30 ft, which allows a 22-ft stroke. The carriage is actuated by an electronically controlled d-c motor driving through a pinion and rack, which provided infinite variations in feed between 0 and 200 in. per min.

The contouring movement of the cutters is controlled by rollers held in contact with form bars by air cylinders, as shown in Fig. 3. The machine is designed to provide a direct one to one relationship between roller and cutter. In this manner the form bars are fabricated to the finished part contour dimensions.

The fixtures were designed to provide rigidity and to

By F. M. Gibian

Supt. of Production Engineering,
Northrop Aircraft, Inc.

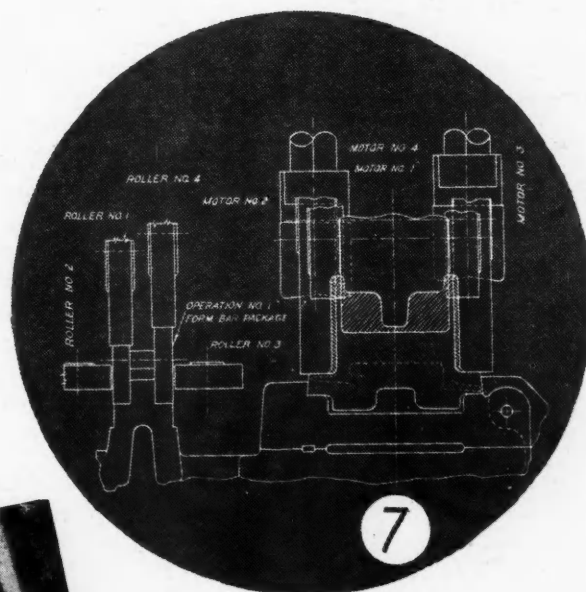


Fig. 7—Sketch for typical spar mill set-up. The cross sectioned part is the material removed during operation No. 1.



Fig. 5 — Closeup of two-tooth carbide-tipped Meehanite cutters.

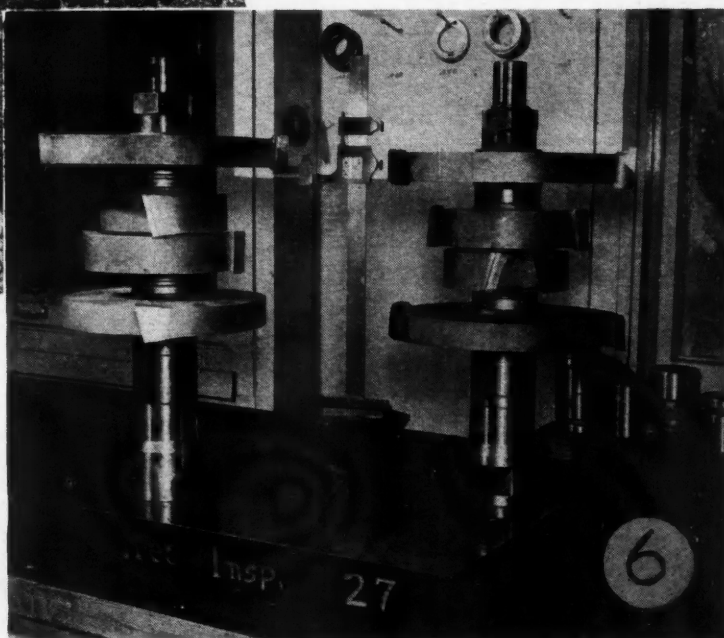
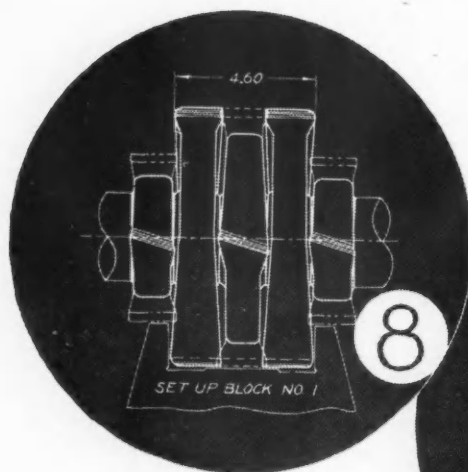


Fig. 6—Cutter assemblies on detachable arbors.



Arrangement of cutters for Operation No. 1.

Fig. 8—Horizontal arbor motor No. 1.

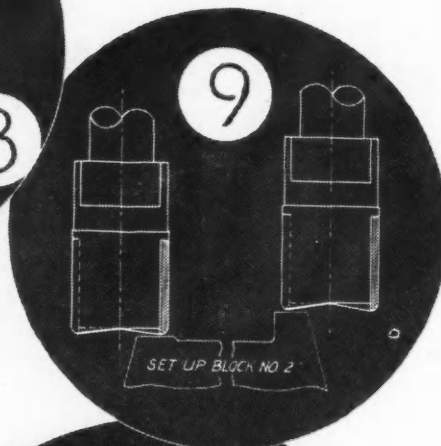


Fig. 9—Vertical spindles motor Nos. 2 and 3.

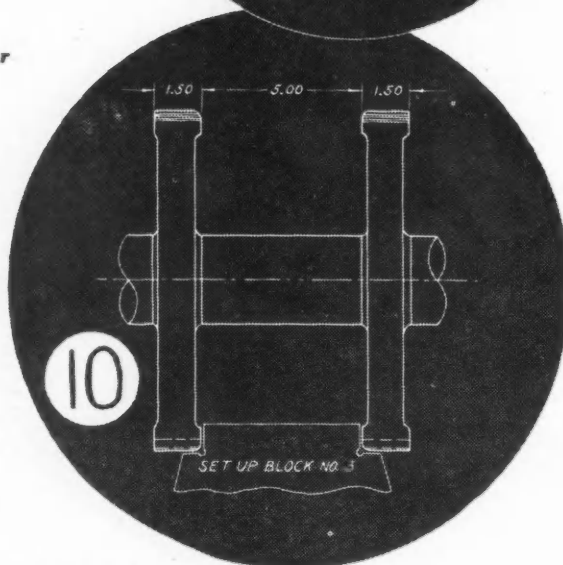


Fig. 10—Horizontal arbor motor No. 4.

facilitate setup time (see Fig. 4). They include a cast Meehanite base which is a Northrop standard for most spar mill fixtures. Thirteen air-actuated clamps, each producing 2000 psi pressure, are attached to the casting equally spaced along the 112 in. bed. The steel form bars for the four rollers are bolted to the bed.

Two-tooth cast Meehanite cutters (Fig. 5) with inserted carbide tips are used for all operations. Cutter assemblies on detachable arbors, shown in Fig. 6, facilitate machine setup time and simplify cutter alignment, since this is a bench operation. We have found that negative rake cutters, used so successfully in milling steel and cast iron, are not satisfactory for spar milling dural because they require too much power and

produce excessive loads on the motor bearings. Although tool life reduces as positive rake angles are increased, the cutter life is so long, even for plus 15 deg axial and plus 15 deg radial rake, that these angles are satisfactory for production. We use plus seven deg rake angles for

most of our spar mill cutters. Feed rates vary between 35 and 200 ipm, averaging 125 ipm, depending on the amount of material being removed and the consequent load on the motors. This is a range of between .005 and .035 in. per tooth. A soluble oil coolant is used for all spar mill operations at a rate of 180 gpm.

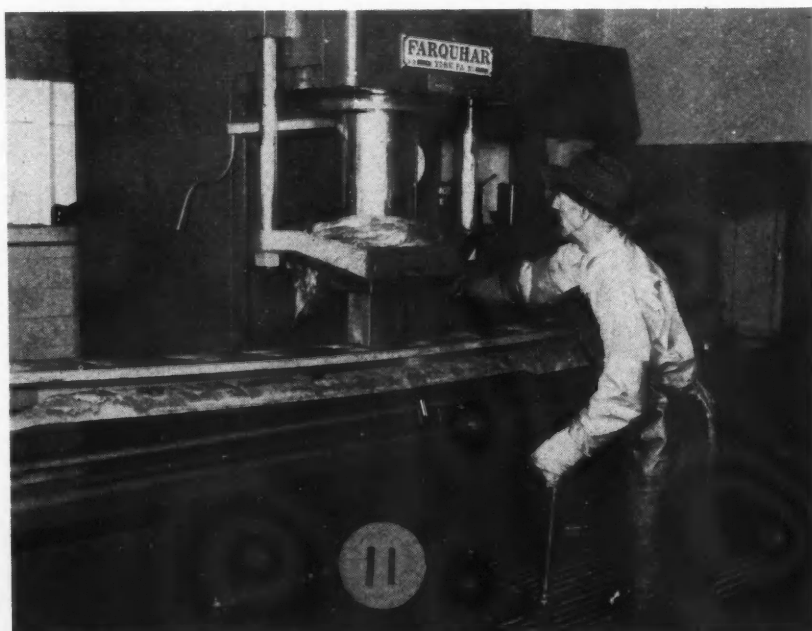
The operation sheet and charts are a typical spar mill setup. The cross sectioned part of Fig. 7 shows the material removed by the four motors during this particular milling operation. Figs. 8, 9 and 10 indicate the cutter arrangement on the arbors of each motor.

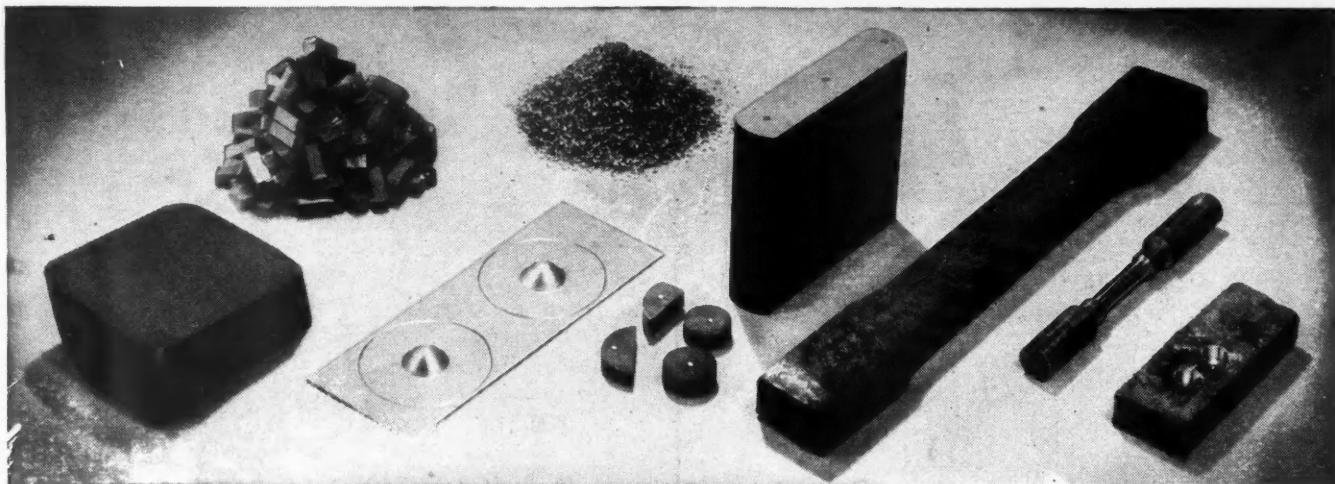
An appreciable amount of distortion is noticed after the first milling operation. However, subsequent milling operations reduce the distortion somewhat. It has proved advisable to straighten the caps after the last spar mill operation since the distortion has been minimized and also since the straightening force is less with the reduced cross-sectional area (see Fig. 11).

Chips (277 lb per cap) are removed by a screw conveyor in the bed of the spar mill which feeds the material on to a vertical belt conveyor at the end of the machine, dropping

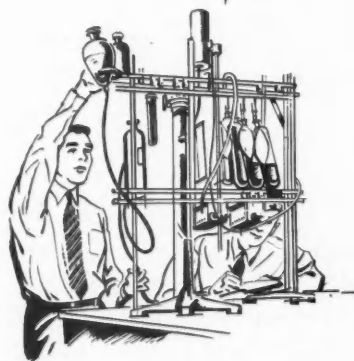
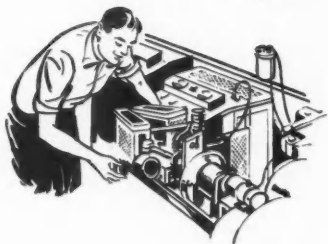
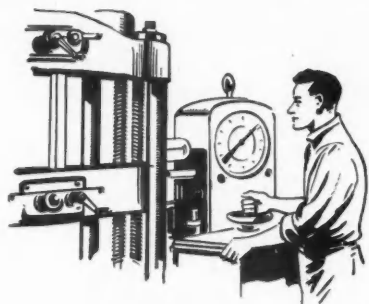
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Fig. 11—Straightening spar cap after last milling operation.





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INLAND STEEL COMPANY

German

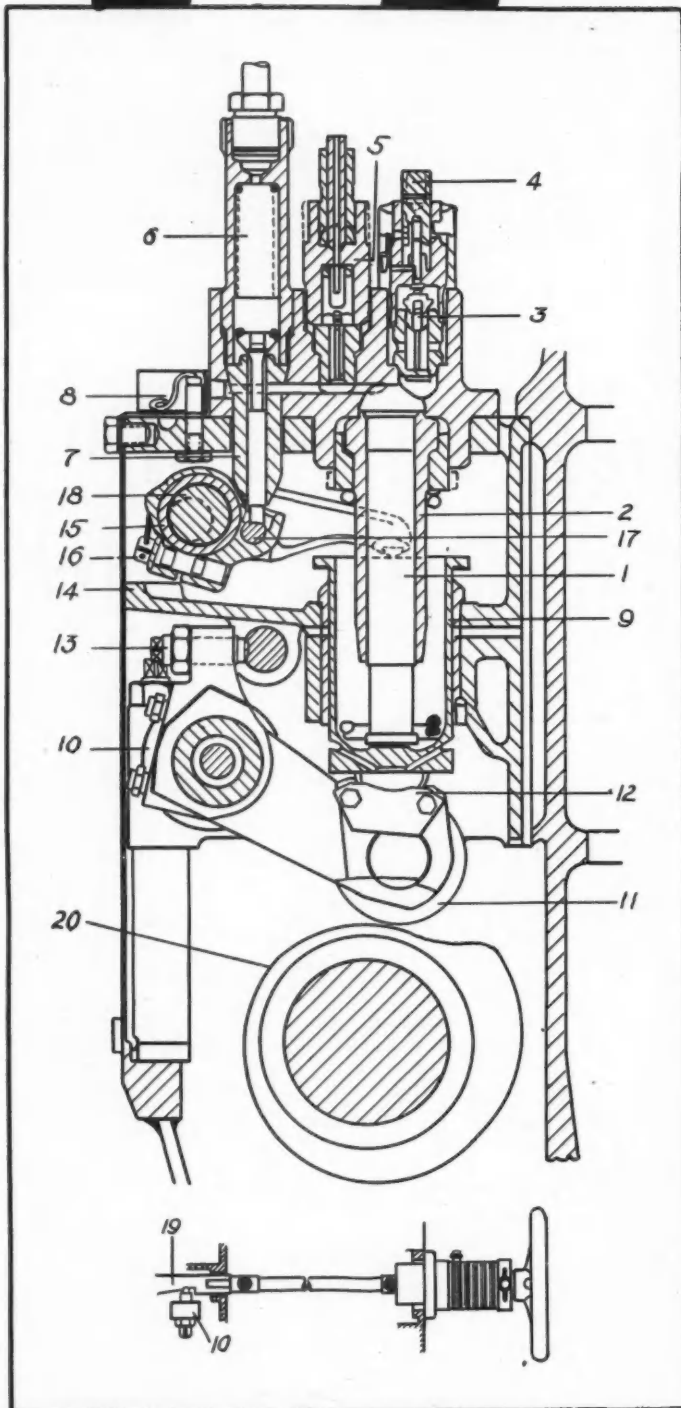


Fig. 1—Fuel Oil Pump and Drive

- | | |
|-----------------------------|--|
| 1 Pump plunger | 12 Pressure plates |
| 2 Plunger guide | 13 Adjusting screw for timing adjustment |
| 3 Suction valve | 14 Overflow valve |
| 4 Cut-off for suction valve | 15 Klemp lever |
| 5 Pressure valve | 16 Klemp screw |
| 6 Overflow valve | 17 Sliding block |
| 7 Overflow valve housing | 18 Adjusting shaft with eccentric |
| 8 Overflow valve cone | 19 Shaft for timing adjustment |
| 9 Spring cup | 20 Fuel oil cam |
| 10 Roller lever | |
| 11 Roller | |

THE type of engine built by the industry of any country is subject to its particular requirements and resources; therefore, any apparent improvements should be evaluated in light of available manufacturing facilities, materials, manpower, uses and economic conditions. The German engine manufacturers were subsidized heavily by the government, and available technical skill was funneled into their research laboratories and experimental plants in order to develop highly efficient power plants for the expected war. Since enough information is now available to form a picture of the result of this all-out German endeavor, the following comparative study was made of high-powered combustion engines used by the armed forces of the United States and Germany.

In Table I the performance and characteristics of three popular slow-speed, long-life, high-powered American Diesel engines are compared with the standard German Diesel engine of comparative size and application. This comparison shows that the German engine produces 25 per cent more power at approximately 31 per cent less engine speed with the same average lb per hp ratio and within approximately the same space requirements as engine A. It should be pointed out that these data have not yet been established under identical test conditions and may be subject to some corrections. There is, however, evidence available to conclude that the German data are of sufficient reliability to be used for a preliminary comparison.

The German engine is of conventional design, single-acting, four-stroke, four valves per head with an exhaust driven centrifugal blower and an intercooler for the air. The use of an intercooler is not customary in this country on standard Diesel engines and warrants investigation. By cooling the air before entering the combustion

space to decrease its volume, thereby increasing the weight of air or the amount of oxygen available per cycle, it is possible to operate the engine with a high

This article is from a report by H. J. Kirschner, of the Transportation Corps' Research and Development Div., Army Service Forces, which was based in part on German data obtained by overseas technical intelligence teams.

Innovations in Diesel Engines

bmp of 138 psi at a compression ratio of 13 to 1 and thus obtain a higher output per cylinder displacement.

By employing only six cylinders, using raw-water cooling, and avoiding the necessity of cooling-water heat-exchangers, maintenance and spare parts supply are simplified. Careful proportioning of cooling water passages and control of the flow, together with accessibility for cleaning and inspection, is essential for a raw-water cooling system, especially when operating at a high bmp. This engine has numerous removable inspection covers in the head and employs zinc inhibitors against corrosion. The German system of fuel injection, shown in Fig. 1, seems complicated and expensive, but it provides for manual injection timing control. The other parts conform with our general design practice except for many refinements, indicating careful study of details and lavish use of skilled manpower.

The advance of the Germans in producing high horsepower output engines is especially pronounced in the lightweight, high-speed field. Table II compares the characteristics of the largest, high-speed,

lightweight U. S. Diesel engine with the standard lightweight German Diesel engine and an American high-power, high-speed gasoline engine. The comparison of a gasoline engine with a Diesel is admittedly not technically correct, but lack-

ing an American lightweight, high-power, Diesel engine of comparable power, and since this gasoline engine has been used for a similar application in this country, the comparison seems justified.

From this comparison, it can be readily shown that

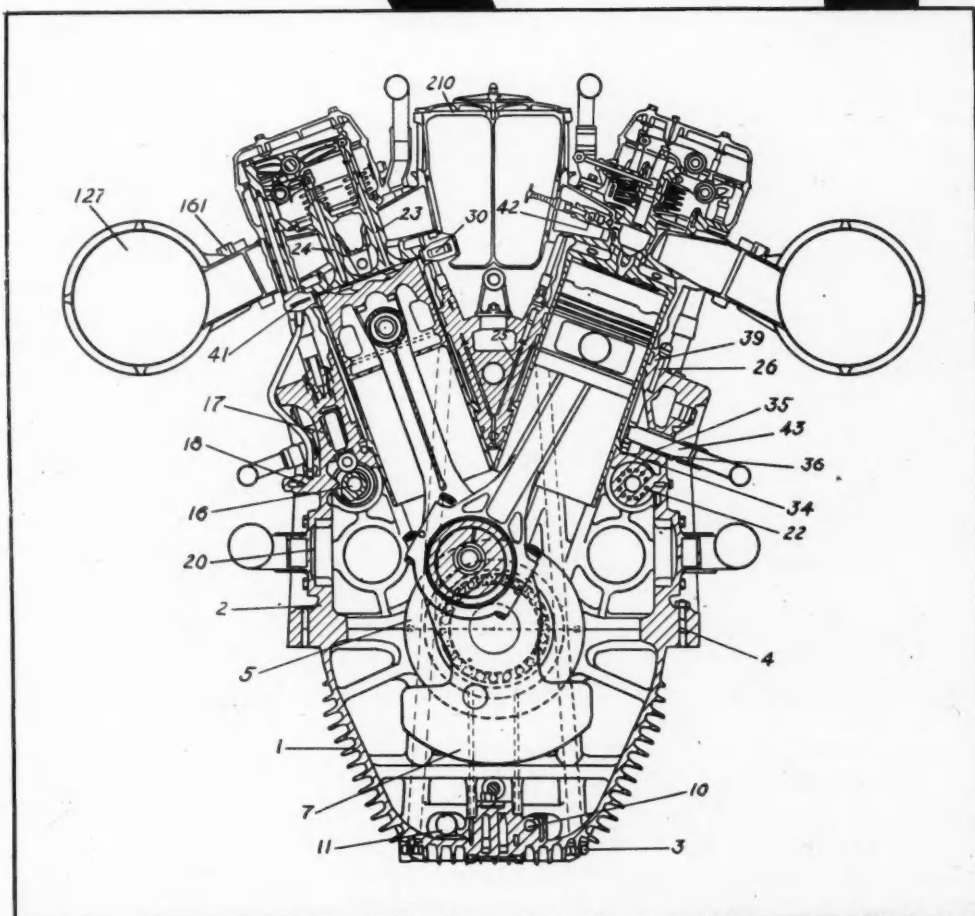


Fig. 2—Cross-section of German 2500 hp Diesel engine

- | | | |
|---|----------------------------------|---------------------------------------|
| 1 Crankcase lower half | 16 Cam shaft | 35 Double deck |
| 2 Crankcase upper half | 17 Cam follower | 36 Fresh water duct bore |
| 3 Tension bolt | 18 Starting air control plunger | 39 Cylinder flange |
| 4 Body fit bolts | 20 Inspection cover | 41 Starting oil valve |
| 5 Dowel | 22 Camshaft bearing sleeve | 42 Glow plug |
| 7 Vertical drill for main bearing lubrication | 23 Inlet valve | 43 Fresh water entrance into cylinder |
| 10 Lower lube oil gallery (pressure line) | 24 Exhaust valve | 127 Exhaust manifold |
| 11 Collecting pipe for suction line of lube oil return pump | 25 Lube oil line drill | 161 Pyrometer fitting |
| | 26 Cylinder body-fit bolts | 210 Cover |
| | 30 Safety valve | |
| | 34 Rubber seal ring for cylinder | |

TABLE I

Comparative Performance Data of American and German Diesel Engines

	A (U. S.)	B (U. S.)	C (U. S.)	German
Rated bhp.....	1600	1600	1950	2000
Rpm.....	750	720	420	520
Weight, lb.....	28,000	33,600	98,500	38,500
Space occupied, cu ft.....	855	678	1300	885
Specific fuel consumption, lb per hp-hr.....	0.40	0.36	0.39	0.37
Bore, in.....	8.75	8.125	16.0	16.0
Stroke, in.....	10.5	10.0	20.0	18.4
No. cylinders.....	16	10	8	8
Displacement, cu in.....	10,100	10,368	32,178	22,100
Cycle, stroke.....	2	2	4	4
Supercharger air pressure, psi.....	none	4	7	9
Bmep, lb per in.....	84	85	115	138
Piston speed, fpm.....	1310	1200	1400	1600
Hp per cu in. displacement.....	0.159	0.154	0.0905	0.0908
Lb per hp.....	17.5	21.1	50.8	19.25
Hp per cu ft. space.....	1.97	2.43	1.5	2.34

the German lightweight engine has 160 per cent more power than the U. S. Diesel engine and 40 per cent more than the U. S. gasoline engine. The life of the U. S. engines, is, however, considerably longer than that of the German engines. It is interesting to note that the horsepower per cylinder of the German engine is more than twice that of the U. S. built Diesel, though the German engine is built on the four-stroke and the U. S. on the two-stroke principle. In lb per hp, the German engine is 22 per cent lighter than the U. S. Diesel. The gasoline engine is 66 per cent lighter than the same reference engine. The ratio of hp to space occupied is about the same for both Diesel engines, while the gasoline engine shows 18 per cent more power per unit of space.

Fig. 2 shows the cross section of the German high-speed engine. It is a 20-cylinder reversible, four-stroke engine with precombustion chambers, centrifugal supercharger and intercooler for the air. Since the high output is based on unusually high piston speed for Diesel engines, it seems worthwhile to further analyze the features which contribute to make high piston speed practical. The precombustion chamber would have the tendency to reduce the peak pressure which in turn will permit the use of lightweight, aluminum alloy pistons. Large bearing diameters in piston pin and crankshaft will reduce the bearing pressures. It should be noted that no piston cooling, or forced feed lubrication to the piston pins, is provided and that the cast iron piston rings ride on untreated chrome steel cylinder walls.

In order to save the maximum amount of weight, the Germans adopted many features, which would be con-

sidered too costly from American standards, requiring a larger number of parts and man-hours. The weight of a reversing gear was eliminated by making the engine reversible. This required many unusual details such as: over-running clutches in the lubricating oil pumps, elaborate shifting mechanism for the camshafts, and pumps designed for both directions of rotation. The use of relatively small split roller bearings for the crankshaft main bearings and camshafts also contributed to make the engine shorter and hence lighter.

The long, chrome steel through-bolts which hold the two crankcases together at the location of the greatest loads near the main bearings, provide another means of weight saving for equal rigidity.

The construction of the cylinder head assembly is unusual for a marine engine. Only the Liberty engine of World War I had a similar construction—a one-piece hollow forging for the head and cylinder. The water jacket, valve ports and air ducts are welded to the forging. The cylinder flange on the German design, however, is closer to the upper end of the sleeve, approximately at the place where the maximum side thrust is produced. Under the reduced load conditions the lower sleeve can be made very light. The omission of a joint between the head and cylinder reduced the quantity of metal for flanges and bolts which have to be cooled in the cylinder block. The cooled air charge

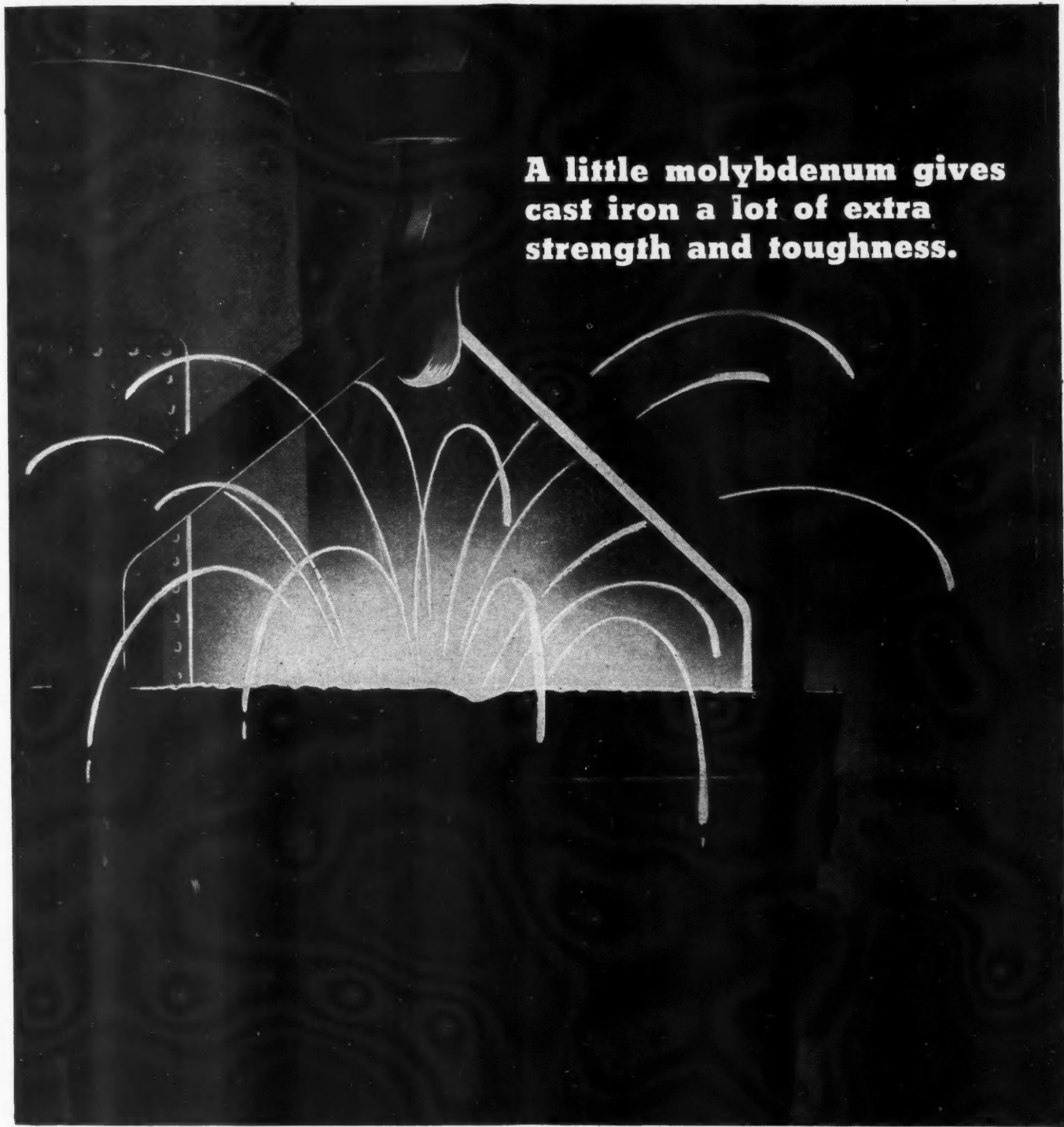
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TABLE II

Comparative Performance and Characteristics of American and German High Speed Engines

	U.S. Diesel	U. S. Gasoline	German Diesel
Bhp at rpm, intermittent rating.....	950 at 1620	1800 at 2800	2500 at 1630
Bhp at rpm, continuous rating.....	770 at 1460	1050 at 2000	1875 at 1480
Weight dry in lb including reduction or reverse gear..	4934	3100	10,000
Propeller shaft rpm, top rating.....	824	2800	950
Space occupied, cu ft.....	144	140	370
Life between overhauls, hr..	3000	750	400 to 700
Bore, in.....	6.0	6.375	7.25
Stroke, in.....	6.5	6.5	6.875
No. cylinders.....	16	12	20
Displacement, cu in.....	2950	2480	8160
Cycle, stroke.....	2	4	4
*Supercharger air pressure, in. mercury.....	34	44	44
*Bmep, psi.....	80	204	140
*Piston speed, fpm.....	1755	3040	2588
*Bhp per cu in. displacement.....	0.328	0.724	0.308
*Lb per hp.....	5.14	1.72	4.0
*Hp per cu ft space.....	6.68	7.8	6.68
Specific fuel consumption, lb per hp-hr.....	0.40 to 0.44	0.50 to 0.66	0.39 to 0.46

* Based on intermittent rating.



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By **E. M. Cope,**

Chief, Statistics Section,

and **S. F. Bielak,**

Associate Highway Economist,
Public Roads Administration

CONSUMPTION of motor fuel on the highways during World War II is an excellent measure of the extent to which the nation found it necessary to move goods and persons over the highways in an extreme emergency. The reduced but continued flow of motor fuel that reached civilian automobiles, trucks, and buses was at once a testimony of efficiency of the petroleum industry and a recognition of the fact that maintenance of highway transportation at a high level was indispensable to the war effort. In analyzing motor-fuel consumption in the war years it is necessary to bear in mind that motor-vehicle registration continued at a high level. The pessimistic predictions which were frequently heard at the beginning of the war fortunately were not fulfilled.

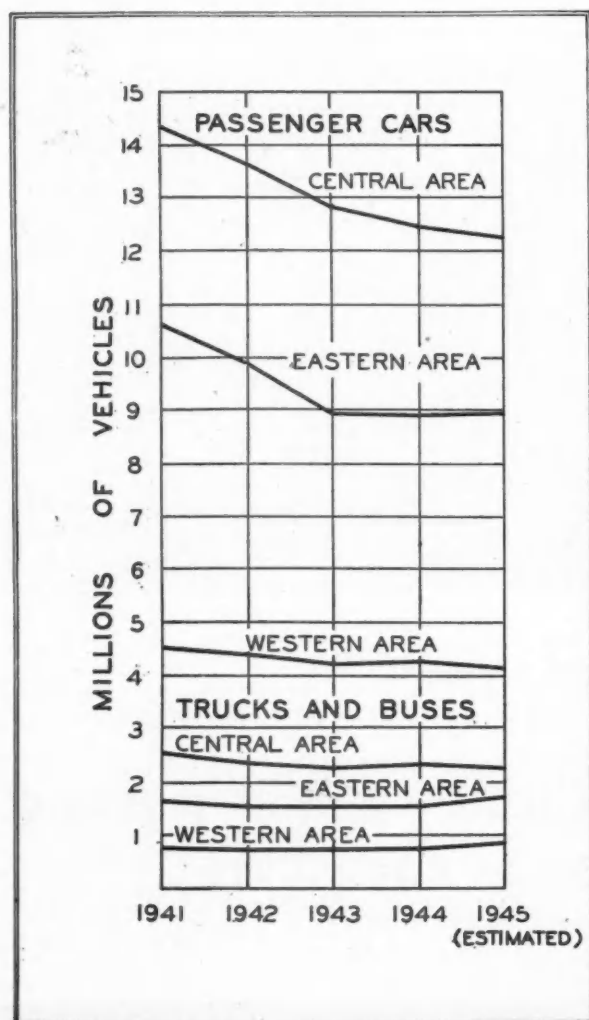


Fig. 1—Registrations of Motor Vehicles by Areas, 1941-1945.

The accompanying tables and figures show the nature of wartime motor-fuel consumption, the previously existing relation between motor-fuel consumption and motor-vehicle registration, and the effect of the war on motor-fuel consumption. The more important restrictions applied to motor fuel are given in Table 1, which also gives the grouping of States used in this article. This grouping was chosen because it seemed to divide the States into the three important groups to which particular wartime controls were applied. The segregation is purely geographical, and no attempt has been made to separate industrial from agricultural areas or allowance made for the numerous minor changes in the areas to which certain restrictions were applied. Table 2 is a summary of the difference between the amount of motor fuel used on the highways and the amount which might have been used had it not been for the war. In Fig. 1 is shown the 1941-1945 trend of motor vehicle registrations by areas. Fig. 2 shows the 1925-1944 trends in motor-vehicle registration and motor-fuel consumption, with estimates for 1945. Fig. 3 shows actual consumption of motor fuel by months for the war years, and Fig. 4 shows the relative consumption for those years.

Wartime Controls on Motor Fuel

The first control on civilian consumption of motor fuel was order L-70, which limited the amount of gas-

Effect of the War on Motor Vehicle Registrations and

Highway

oline that could be delivered to bulk consumers or service stations in any one quota month to 80 percent of one-third of the deliveries during the three months December 1, 1941, to February 28, 1942, adjusted for seasonal variations or an abnormal base period. This order applied to the 17 Eastern States and the District of Columbia (except for the extreme western part of

Table 1—Important Wartime Motor-Fuel Rationing Controls

Date	Area Affected ¹	Order of Action
March 19, 1942	17 Eastern States, District of Columbia, Oregon and Washington.	Order L-70. Limiting delivery of gasoline to bulk consumers or service stations to 80 percent per month, based on average of three-month period December 1, 1941 to February 28, 1942.
May 15, 1942	17 Eastern States and District of Columbia.	R. O. 5. Beginning of card rationing. "A" "B" and "X" cards issued. This plan was in effect until July 22, 1942 when ration coupon books were issued.
July 18, 1942	Eastern Area, excluding certain Westernmost Counties of New York, Pennsylvania, Maryland, West Virginia and Florida.	L-70 Amended. Delivery to bulk consumers or service stations limited to 50 percent of base period, from July 18, 1942 to July 21, 1942, and 66½ percent thereafter.
July 22, 1942	Oregon, Washington and Western New York Counties.	L-70 Amended. Delivery to bulk consumers or service stations limited to 66½ percent of base period.
July 22, 1942	Those portions of Eastern States not included in Order of July 18, 1942.	L-70 Amended. Limitation to bulk consumers and service stations set at 75 percent of base period.
July 22, 1942	Eastern Area, excluding Western Counties of New York, Pennsylvania, Maryland, West Virginia and Florida.	Inception of Coupon Rationing. Values—"A", "B" and "C" 4 gallons. "A" value of 16 gallons per month assumed to contain 150 occupational miles per month, "B" 320 miles per month and "C" for preferential driving over 470 miles per month.
November 22, 1942	Eastern Area.	"A" coupon value cut from 4 to 3 gallons and monthly allowance from 16 to 12 gallons.
December 1, 1942	Central and Western Areas.	R.O. 8C. Extension of coupon rationing to entire nation. Coupon values 4 gallons. "A" ration 16 gallons per month. "B" and "C" same as in eastern Area. "T" coupon issued for commercial vehicles.
December 21, 1942	Eastern Area.	"B" and "C" coupon values cut from 4 to 3 gallons. Occupational mileage "B" ration reduced from 320 to 288 miles per month.
January 7, 1943	Eastern Area.	Pleasure driving ban invoked.
March 3, 1943	Eastern Area.	Enforcement of pleasure driving ban relaxed.
March 22, 1943	Eastern Area.	"A" coupon value cut in half by extending period from two to four months. Allowance now six gallons per month.
May 20, 1943	Eastern Area.	Second pleasure driving ban invoked.
May 25, 1943	Eastern Area.	"T" coupon period extended from 3 months to 115 days.
June 2, 1943	Eastern Area.	"B" and "C" coupon value cut from 3 to 2½ gallons. "B" mileage ceiling reduced from 360 to 300 miles per month. No mileage adjustment provided for in cut.
August 16, 1943	Central and Western Areas, but excluding Arizona, California Nevada, Oregon and Washington.	"A" "B" and "C" coupon values cut from 4 to 3 gallons. "A" ration allowance cut from 16 to 12 gallons per month. "B" ceiling set at 420 miles per month.
October 1, 1943	Eastern Area.	"A" ration allowance increased from 6 to 8 gallons per month by shortening period from 4 to 3 months.
October 1, 1943	Eastern, Central and Western but excluding Arizona, California, Nevada, Oregon and Washington.	"B" and "C" coupon values cut from 3 to 2 gallons. No loss in monthly mileage allowance.
October 12, 1943	Arizona, California, Nevada, Oregon and Washington.	"A" coupon value cut from 4 to 3 gallons, and monthly allowance from 16 to 12 gallons.
December 1, 1943	All Areas.	New "B" and "C" coupons issued with a value of 5 gallons each. No change in mileage allowance.
December 1, 1943	Eastern Area.	"B" ration monthly mileage ceiling increased from 300 to 325 gallons.
March 21, 1944	Central and Western Areas.	"A" coupon ration lowered by extending period from 3 to 4 months. Monthly allowance cut from 12 to 8 gallons.
June 22, 1945	All Areas.	"A" coupon ration increased from 8 to 12 gallons per month.
August 15, 1944	All Areas.	Rationing of gasoline ended.

¹ All references to area groups are as outlined in the segregation of states shown below. Exceptions where noted are those affecting an area to a marked degree. Minor deviations from these areas in the application of controls applied by the Office of Price Administration and Petroleum Administration for War, are not noted.

EASTERN AREA			CENTRAL AREA			WESTERN AREA		
Connecticut	Massachusetts	Rhode Island	Alabama	Louisiana	Ohio	Arizona	New Mexico	
Delaware	New Hampshire	South Carolina	Arkansas	Michigan	Oklahoma	California	Oregon	
Florida	New Jersey	Vermont	Illinois	Minnesota	South Dakota	Colorado	Utah	
Georgia	New York	Virginia	Indiana	Mississippi	Tennessee	Idaho	Washington	
Maine	North Carolina	West Virginia	Iowa	Missouri	Texas	Montana	Wyoming	
Maryland	Pennsylvania	District of Columbia	Kansas	Nebraska	Wisconsin	Nevada		
			Kentucky	North Dakota				

Motor Fuel Consumption

Florida), and to Oregon and Washington. Order L-70 was later amended both as to the amounts and to the territory covered. These changes are given in the chronology.

Despite the application of L-70, no serious shortage of gasoline was felt immediately. The general public was aware that it was necessary to conserve vehicles

and tires as there was little likelihood that either could be readily replaced, and hence driving was voluntarily curtailed.

So much of the motor-fuel production was soon going into military channels that it was necessary to ration motor fuel in the eastern area. "Card" rationing was required in the East on May 15, 1942. Card

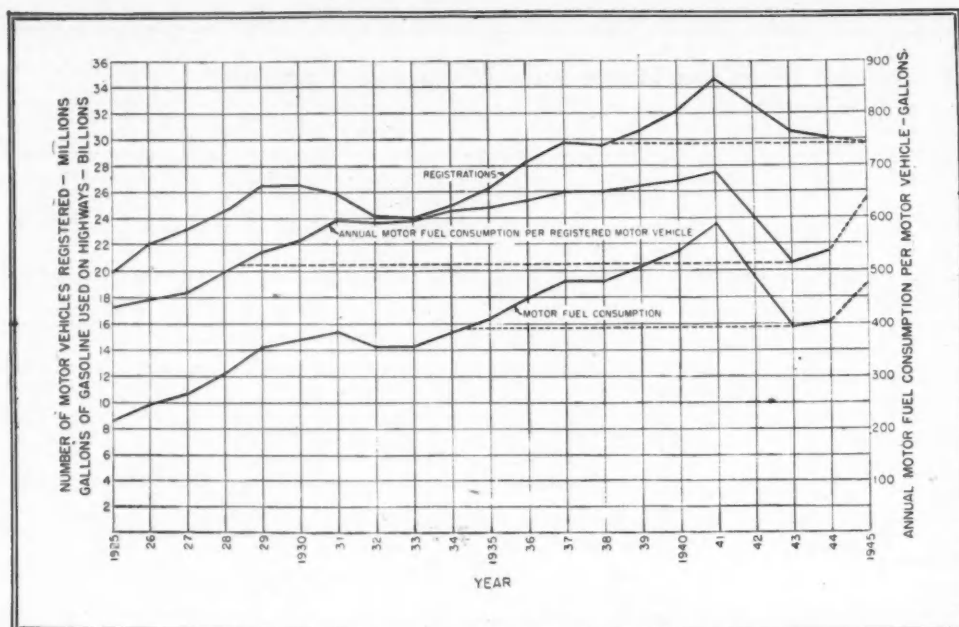


Fig. 2 — Trend in Motor Vehicle Registration and Motor Fuel Consumption, 1925-1945.

6.6 percent decrease in registrations between 1931 and 1932 at the bottom of the depression. The decrease from 1943 to 1944 was only 413,419, and current indications are that the 1944-1945 decrease may possibly be less than that of 1943-1944.

For the three-year period as a whole, the greatest decrease was 15.2 percent in the eastern area (see Fig. 1). The central and

rationing was found to be inadequate and was followed on July 22, by "coupon" rationing in the East. The extension of coupon rationing to the entire nation on December 1, 1942, was probably the most important of all wartime motor-fuel controls.

The ban on "pleasure driving" imposed in the Eastern States was reflected by remarkable decreases in traffic, but as no coupons expired during the periods the bans were in effect, and no coupons were invalidated, it is doubtful if it had an important effect on the total amount of motor fuel consumed. However, the ban did substantially relieve critical temporary shortages.

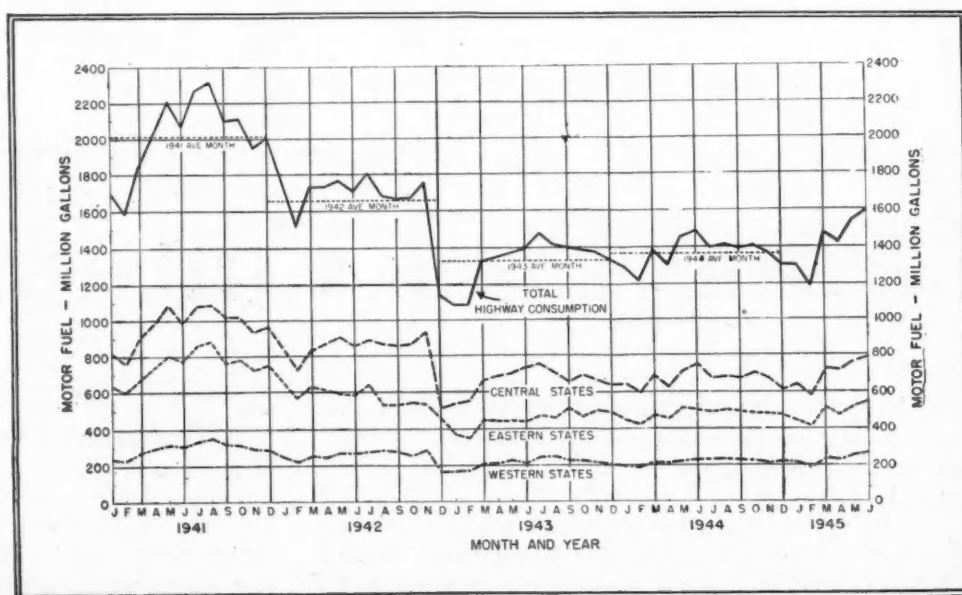
Motor-Vehicle Registration

There were 34,472,145 automobiles, buses, and trucks registered in 1941 (excluding those owned by Federal, State, and local governments). In 1942 there were 1,889,903 fewer vehicles registered, and the decrease from 1942 to 1943 of 2,082,634 was the greatest of any year on record. In terms of percentage, however, this decrease of 6.4 percent between 1942 and 1943 was slightly less than the

western areas showed decreases of 12.9 percent and 6.6 percent, respectively. It is probable that the establishment of new industries and the great expansion of old industries in the West accounts for the relatively better showing of that area. Another important factor was that in the eastern and central areas many war industries were located where there already existed highly developed mass transportation systems. For the country as a whole, the decrease was 12.7 percent during the period 1941 through 1944.

The greatest decrease in registration in the three war years occurred in the District of Columbia, where there were 28.8 percent fewer vehicles in 1944 than in 1941. It is believed that this figure is somewhat misleading since large new apartment developments in nearby areas, particularly in Virginia, attracted a

Fig. 3 — Highway Motor Fuel Consumption in the United States by Areas, 1941-1945.





Kilroy was there... so was I!

YES SIR, I was there, right from Pearl Harbor to V-J. I helped the boys do their jobs... all over the map!

You folks on the home front sure were swell holding down your gripes about shipments and such, during the days when Ol' Permatex was up to its ears in Government Orders.

But from now on I'm back at the Plant, pushing out those "can't-be-beat" Permatex Products you've waited for so long.

Well, I guess that does it. Just want to say "Hi" to my many friends, both old and new... I'll be seeing you!

PERMATEX COMPANY, INC., BROOKLYN 29, N. Y., U.S.A.

considerable number of individuals who had previously registered their vehicles in the District of Columbia. Such vehicles were not removed from the Washington metropolitan area.

Utah, with an increase of 1.9 percent in the three-year period, was the only State which reported more vehicles for 1944 than in 1941. This was the result of war activities, particularly the establishment of new industries.

It is remarkable that in 1944, the third year of the war, the registrations in many States were greater than they were in 1943. This was particularly true in

able that the 1945 rate of consumption will be approximately 600 gallons per vehicle. Total motor-fuel consumption on the highways reached the lowest point of the war years in 1943, when it was at approximately the 1934 level.

It is impossible to determine accurately what motor-fuel consumption would have been had there been no war. For the purpose of comparison, however, Table 2 shows highway motor-fuel consumption for 1942, 1943, and 1944 and an estimate for 1945, together with an extrapolation of the least squares trend line established in the years 1925 through 1941.

Fig. 3 shows highway consumption of motor fuel by months for January 1941 through June 1945. A comparison of the curves for the three areas shows that the Eastern States were by far the most affected by gasoline rationing and other wartime restrictions. The most notable drop in the rate of fuel consumption occurred in the Central States immediately after the inception of gasoline rationing. It will be noted, however, that during November 1942 immediately preceding rationing, motor-fuel consumption in the central and western areas was greater than any other month during 1942 and greater than

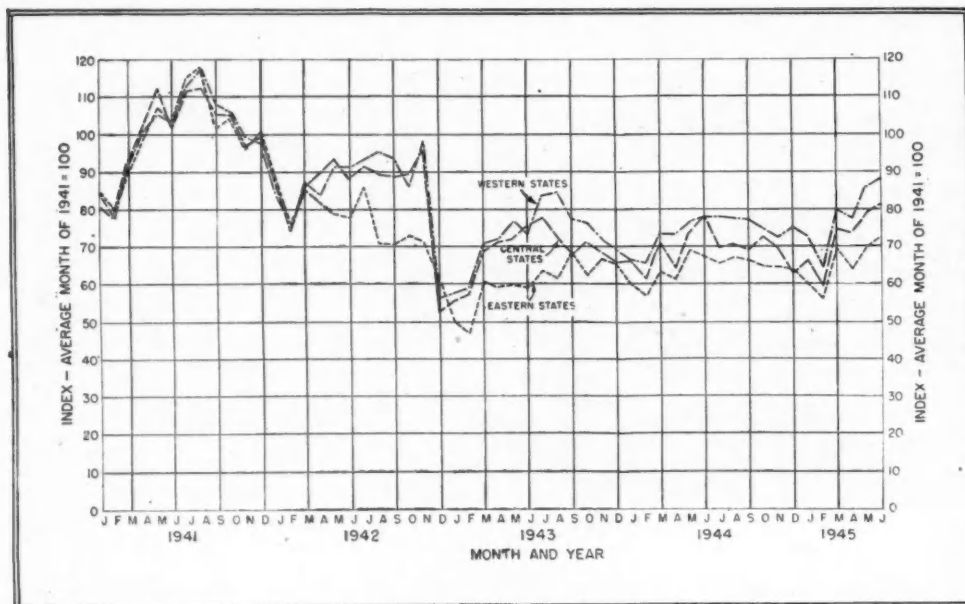


Fig. 4—Relative Highway Motor Fuel Consumption by Areas, 1941-1945.

the Western States where the supply and use of gasoline had not been subject to the degree of restriction necessary in the East. Perhaps the greatest factor, however, in the continued high level of registration in the Western States was the influx of large numbers of people to work in war industries, particularly shipyards and aircraft factories.

Long-Term Trends

Fig. 2 shows the long-term trends in total highway motor-fuel consumption and consumption per vehicle, together with total motor-vehicle registration, for the years 1925-1944. Motor-fuel consumption, both in total and on a per-vehicle basis, was less subject to fluctuation prior to 1941 than was registration. Wartime controls, however, caused motor-fuel consumption to decrease with, but faster than, registrations in the 1941-1943 period. In 1941, the average fuel consumption per motor vehicle was 686 gallons. By 1943 it was down to 514 gallons, or approximately the 1928 rate of consumption. It appears from data now avail-

any month since then. The facts suggest that storage of motor fuel in anticipation of rationing accounts for both the high recorded consumption in November and the very low consumption in December, January, and February in the central and western areas. The sub-

(Turn to page 68, please)

Table 2. Civilian Consumption of Motor Fuel on Highways

(In millions of gallons)

Year	Actual consumption	Trend value ¹	Difference
1942	19,473	22,905	-3,432
1943	15,668	23,705	-8,037
1944	16,080	24,505	-8,415
1945	19,000 ²	25,304	-6,304

¹ Taken from simple extrapolation of 1925-1941 least squares trend line.

² Estimated.

especially prepared for permanent storage



Optical range finder for coast artillery, stored in Saran Film by the Rowe Packaging Company, Ltd., of Toronto, consultants to the directorate of mechanical engineering of the Canadian Army—Official Canadian Army Photograph.

CANADA CHOOSES SARAN FILM

In a major peacetime application, the Canadian Government is giving Saran Film (pronounced Sah-ran) the job of protecting millions of dollars worth of coast defense equipment, placed in extended storage but *ready for instant use*.

Saran Film was specified after thorough investigation of all packaging materials and methods, some of them much more elaborate and expensive. Saran Film was chosen because it is transparent, pliable, strong, won't become brittle and crack upon aging and is easily handled. But, most important of all, it was selected because it "keeps moisture in its place."

Along with many advantages, Saran Film is giving the Canadian Government the lowest cost for the job.

Saran Film offers highest-degree protection for a broad variety of products. For the storage of fine machinery, precision instruments, electric motors, metal assemblies and parts, or for the delivery of these and other products *clean and ready to use*—investigate Saran Film. Call any Dow sales office.

Saran film

K E E P S M O I S T U R E I N I T S P L A C E

PRESENT AND POTENTIAL USES: Method II packaging, dehydrated packages for metal parts and assemblies, packing corrosive and anhydrous chemicals, bottle closure liners, flexible containers requiring good moisture vapor and gas impedance, etc.

PROPERTIES AND ADVANTAGES: Highest degree protection against moisture vapor transmission. Soft, pliable, yet tough and strong. Corrosion-resistant. Clear, transparent film. Modified heat sealing equipment recommended. Thickness range .001 to .003 inch.

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STYRON • SARAN • SARAN FILM

Recent Wage Increases Expected to Result in Higher New Car Prices

OPA'S Principle of Cost Absorption Likely to Hold Price Boost to Less than Full Increase in Wages

Effects of the government's price wage policy on the automobile industry still are difficult to assay accurately. One inescapable conclusion reached in Detroit is that prices of new cars probably will go up as soon as the mechanics of relating the recent increases in wages to new car prices can be worked out. This does not mean necessarily that the full increase in wages will be allowed in the price boost, since OPA's often repeated principle of cost absorption is likely to govern to some extent. However, the inevitable result of present and recent labor troubles will be higher prices all along the line in the automobile and other industries, in the opinion of most observers.

Whether or not production troubles so far as labor is concerned will be over with settlement of the steel and General Motors strikes remains to be seen. The flow of parts from component manufacturers has been spotty ever since civilian production was resumed beginning with Ford last July. The general consensus among parts manufacturers in Detroit is that settlement of the steel strike will not usher in an era of peace immediately, nor will the industry merely follow the pattern of the steel settlement as a matter of course.

The prospects are for a period of shaking down before the parts industry will come to an even keel. Most unions are serving notice that they want the same 17-18-19 cents an hour increase pattern to prevail among the parts makers. However, the companies are resisting such a pat solution on the grounds that percentagewise it would add up to a much greater increase than was given by the car manufacturers. Many parts companies already had given wage increases of from 25 to 33 per cent over 1941 levels. An 18-cent increase would put these companies far ahead of the automobile manufacturers percentagewise in the amount granted in wage boosts over 1941 levels. Frank Rising, general manager of Automotive and Aviation Parts Mfrs., Inc., has compiled some interesting figures to illustrate this point.

The table herewith prepared by Rising shows recent settlements and proposed settlements and how they ex-

ceed cost of living adjustments of 33 per cent.

Rising comments that "it is apparent that many parts companies will be making a much more liberal settlement than any of those listed if they grant the 18, 18½, or 19 cent demand of the union. For example, using the Parts Industry Original Equipment Group averages, 16.9 cents would equal the most liberal auto industry settlement, while the one parts company shown would equal the most liberal auto industry settlement with an increase of 13.8 cents. The parts company faced with these demands should remember the facts show that there is no uniform pattern and should study its situation with its own history in mind."

Price ceilings still are an important impediment in the parts industry, even though controls have been lifted on original equipment for passenger cars. However, this benefit is more apparent than real, since parts makers are subject to secondary ceilings through automobile manufacturers who have a rigid ceiling on the finished product. In fact, there are cases of record where parts makers have given up the manufacture of automotive parts in favor of more lucrative lines on which they can obtain much more profit. A former supplier to Ford notified the company he no longer was interested in furnishing a certain part, since he could make much more money manufacturing metal toys. What will happen to the parts makers under the new wage-price policy still is uncertain, although some relief is bound to come. Replacement parts are under ceilings and there is little hope for any suspension there,

according to reports from Washington. Original and replacement truck parts also still are under controls, despite OPA's virtual promise several months ago that they would be lifted from original equipment components. So all in all, the lot of the parts companies is not a particularly happy one, and as a result the supply of parts for the car manufacturers is likely to be hazardous for awhile.

Following settlement of the wage issues at Ford and Chrysler, the UAW-
(Turn to page 108, please)

Record Attendance at 27th National Metal Congress and Exposition

The combination of pent-up hunger for new developments and an appetite for participation in technical conventions which remained unsatisfied during the war resulted in the large crowds at the 27th National Metal Congress and Exposition held in Cleveland early this month.

Although attendance figures are difficult to substantiate, it is no exaggeration to say that something like 40,000 people thronged Cleveland's public auditorium to view the exhibits displayed by some 450 organizations. Among those attending were metallurgists, chemists, process engineers, and others interested in the latest developments in the field of materials, their treatment, and utilization.

At the same time the American Society for Metals held technical sessions and round tables on subjects of intense interest to metallurgists and engineers. The American Industrial Radium and X-Ray Society also held technical sessions for its members.

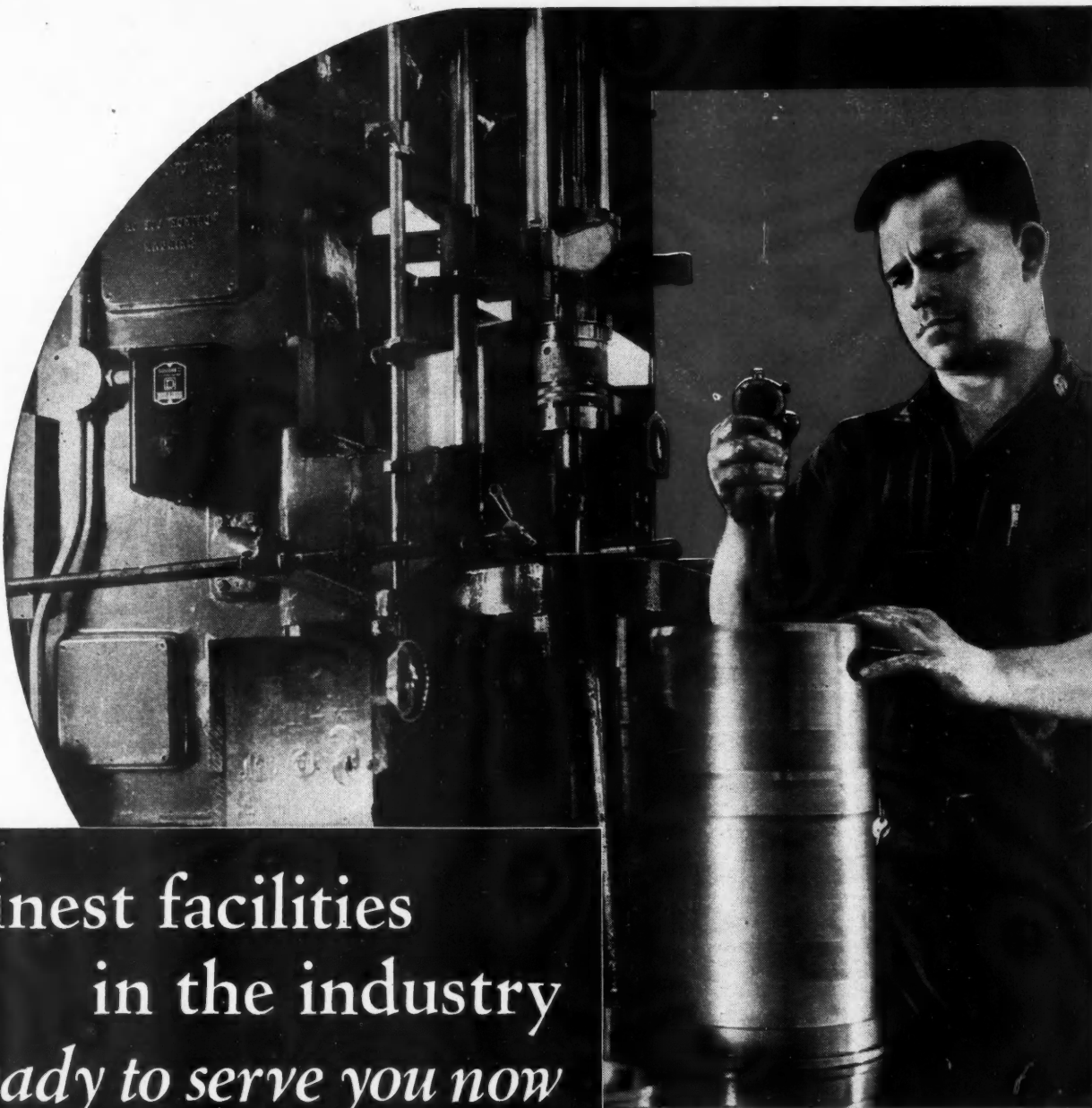
Four important awards for metallurgical achievements were made by the American Society for Metals at its annual banquet. Gerard Swope, retired president and director, General

Wage Settlements and Proposed Wage Settlements

Company	Jan. '41 average rates	Cost of living increases	Jan. '41 plus 33%	Recent average rate	Wage increase recommended by panels or agreed on	Increase needed to equal 33% increase over '41	Excess over cost of living
U. S. Steel	.852	.281	1.133	1.055	.185	.078	.107
General Motors	.916	.302	1.218	1.119	.195	.099	.096
Ford	.84	.31	1.25	1.21	.16	.04	.14
Chrysler	.888	.325	1.311	1.13	.185	.181	.004
Studebaker	1.02	.34	1.36	1.20*	.185**	.16	.026
Parts Industry (Original Equipment Group Average)	.877	.289	1.166	1.137	?	.029	?
A large parts company	.909	.30	1.209	1.207	?	.002	?

* Prior to 12¢ increase in September. After increase, rate was \$1.32.

** Of which 12¢ already granted. Assumes Studebaker would go to total increase of 18.5¢ to comply with agreement to meet Detroit rates.



**Finest facilities
in the industry
*ready to serve you now***

*Precision gauge checking accuracy of honing
operation*

FOR 34 years Sealed Power laboratory and manufacturing facilities have led the industry. Today Sealed Power's factories, laboratories, and personnel are the finest in all our history. You are invited to use the full resources of Sealed Power to help make your good engines even better.



**Keep your War Bonds
Get \$4 for \$3**

SEALED POWER CORPORATION

Muskegon, Michigan • Windsor, Ontario

SEALED POWER PISTON RINGS
PISTONS—CYLINDER SLEEVES

Electric Co., received the ASM Medal for the Advancement of Research. Earle C. Smith, chief metallurgist, Republic Steel Corp., was awarded the Gold Medal of ASM in recognition of outstanding metallurgical knowledge and mature ability. Robert S. Archer, metallurgical assistant to the vice president, Climax-Molybdenum Co., was honored with the 1945 Sauveur Achievement Award for stimulating metallurgical research. The fourth award was the 1945 Henry Marion Howe Medal to three authors of a paper judged of highest merit presented before the Society. These authors are: Dara P. Antia, Indian Aluminum Co., Morris Cohen, Professor of Physical Metallurgy at M. I. T., and Stewart G. Fletcher, Latrobe Electric Steel Co.

Briefly, the exhibits covered the field of structural materials both ferrous and nonferrous, with considerable attention to heat resisting alloys and the light metals such as aluminum and magnesium. Allied with these were displays of processes—metal cleaning, heat treating, induction heating equipment of various types, flame hardening, electroplating, and the like. A considerable proportion of exhibits covered metal cutting processes and equipment—cutting tools, cemented carbides, small metalworking machines, presses, etc. Quality control devices ranging from measurement of surface finish to dimensional control, and magnetic and electronic equipment for rapid inspection of metallurgical quality of materials also were shown. Some examples of the latest technique for checking the soundness of parts and raw materials by means of supersonic measurement also were seen publicly for the first time, as these were subject to restrictions during the war.

Considerable attention was given to some half-dozen displays of another of the arts developed during the war—the technique of producing small precision castings in ferrous and nonferrous metals, using mainly the so-called “lost” wax process, which is credited to Benvenuto Cellini, famous artist and inventor of the Sixteenth Century, who described his process in his autobiography. Among those specializing in this activity are well known organizations such as Briggs Mfg. Co., who uses plaster molds but does not depend upon “lost” wax, and the Michigan Steel Castings Co., producers of small precision steel castings of intricate form.

By and large there were no really startling new materials or techniques at the show. Generally speaking, the metallurgists and engineers who participated in top priority programs during the war found the exhibits quite familiar. However, many engineers and technical people who were not actively engaged in such projects were bound to find much that was new and interesting, and certainly a great deal that will be made available to industry in general for the first time.

SAE German Engineering Evaluation Meeting

Conversion of German automotive engineering data, technique, materials, and progress to the uses of American industry and ultimate service of the American public will be inaugurated at an SAE German Engineering Evaluation Meeting scheduled for March 4 next at Detroit, Mich.

General manager John A. C. Warner, of the Society of Automotive Engineers, has announced the meeting will be held in Detroit's Rackham Educational Memorial to facilitate public presentation of findings by various American engineering missions which have been studying German automotive developments. He said the affair is sponsored by SAE Passenger Car and Truck and Bus Engineering Activities, and represents peacetime continuation of SAE's advisory engineering service to the American military. L. W. Fisher, of Timken-Detroit Axle Co., Detroit, will be general chairman of the meeting. The tentative schedule follows:

MORNING

“Technical Investigations of German Automotive Material,” by Lt. Col. C. H. Corey, Ordnance Dept., Detroit.

“German Army Vehicle Engines,” by Maurice A. Thorne, General Motors Corp., Detroit.

“German Radiators and Oil Cooler Structures and Facilities for Manufacture,” by Fred M. Young, Young Radiator Co., Racine, Wis.

AFTERNOON

“German Automotive Transmission Systems, Development and Design,” by R. R. Burkhalter, Spicer Mfg. Corp., Toledo, Ohio.

“The Highlights of German Transmission Design and Development,” by Lt. Col. Ewen McEwen, Fighting Vehicle Design Department, British Ministry of Supply.

“Suspensions and Track of German Military Track-Laying Vehicles,” by Tore Franzen, Chrysler Corp., Detroit.

“Observations of Various German Suspensions and Steering Gears,” by R. L. Weider, White Motor Co., Cleveland, Ohio.

“Observations on the German Rubber Industry,” by Earl W. Glen, of Good-year Tire & Rubber Co., Akron, Ohio; Assistant Director, Rubber Division, Civilian Production Administration, Washington.

DINNER

“American Design Engineers Move to the Front,” Col. Colby.

EVENING

“German Military Fuels and Lubricants,” by Major N. L. Klein, Ordnance Dept., Washington, D. C.

“War Developments of the Oil Industry in Austria and Roumania,” by

Major L. J. Grunder, Technical Div., Army-Navy Petroleum Board, Washington.

“German Autobahn—Relationship to German Industrial Economy—Traffic Systems,” by Col. John Wheeler, Chicago Burlington & Quincy Railroad, Chicago, Ill.

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE and AVIATION INDUSTRIES

General business activity has dropped to the lowest level recorded since August, 1945. The *New York Times* index for the week ended January 26 stands at 114.2, as compared with 129.4 for the preceding week and 146.5 a year ago.

Sales of department stores, as reported by the Federal Reserve Board, for the week ended January 26 declined slightly to a total 17 per cent above the corresponding distribution in 1945.

Electric power production during the same week was further reduced. The output, according to tentative estimates, was 11.7 per cent below the comparable amount last year, as against a similar decline of 9.7 per cent registered in the week before.

Railway freight loadings during the week ended January 26 totaled 709,136 cars, 5.4 per cent fewer than for the preceding week and 6.6 per cent below the corresponding number a year ago.

Crude oil production in the same week averaged 4,626,300 barrels daily, 20,350 barrels less than the preceding weekly output and 2.2 per cent below the comparable figure in 1945.

Bituminous coal and lignite production during the week ended January 19 totaled 12,800,000 net tons, 10.3 per cent more than the output in the week before. The amount thus far reported in 1946, however, is 4.9 per cent below the corresponding quantity recorded last year.

Civil engineering construction volume reported for the final week of January by *Engineering News-Record* is 31 per cent less than the preceding weekly figure but 144 per cent greater than the amount registered a year ago. The five-week total shown for 1946 is \$348,277,000, or 198 per cent more than the comparable sum in 1945.

The wholesale price index of the Bureau of Labor Statistics for the week ended January 19 remained at the level reported for the week before, 106.7 per cent of the 1926 average, as compared with 104.8 a year ago.

Member bank reserves declined \$178,000,000 during the week ended January 30. Underlying changes reflected include a decrease of \$24,000,000 in Reserve bank credit and a rise of \$184,000,000 in Treasury deposits with Federal Reserve banks, accompanied by a reduction of \$63,000,000 in money in circulation.

Total loans and investments of reporting member banks declined \$108,000,000 during the preceding week. A reduction of \$21,000,000 in commercial, industrial and agricultural loans was recorded. The sum of these business loans, \$7,275,000,000, shows a net increase of \$888,000,000 in twelve months.



Finishing

In designing die castings which are to be plated, all significant areas should be made accessible for buffing. A brilliant luster cannot be obtained in those areas which the buffing wheel cannot reach. This — and the following salient facts — should be considered when castings are to be plated:

1. Deep or narrow recesses are difficult to plate and they tend to entrap the buffing compound.
2. Generous radii in re-entrant angles prevent the necessity for applying excessive thickness of plate to meet minimum coating requirements at the radii.
3. Sharp outside edges, corners and points should be avoided because deposits on such areas tend to be rough and brittle.
4. Convex surfaces are easier to plate than flat surfaces or deep concave areas.
5. Where beads are used for decorative effects, buffing is facilitated if the beads

are parallel to the length of the casting and in the plane of the buffing wheel.

The zinc alloy die casting shown here (a control panel for an electric range) is a good example of designing for ease of finishing. The decorative beads run parallel to the length of the casting and the spaces between the beads are finished in black enamel to contrast with the overall plating of the part. The lettering below the control knob openings is recessed and also finished in the contrasting black enamel. All recesses are shallow and all significant areas can be reached by the buffing wheel.

Additional data on designing for ease of finishing will be found in our booklet "Designing For Die Casting". To insure that you will get the most from your die casting dollar, ask us—or your die casting source—for a copy of this booklet.



THE NEW JERSEY ZINC COMPANY

160 Front St., New York 7, N. Y.



ZINC
FOR DIE CASTING ALLOYS

The Research was done, the Alloys were developed, and most Die Castings are based on
HORSE HEAD SPECIAL (99.99+% Uniform Quality) ZINC

PERSONALS

Recent Appointments Among Automotive and Aviation Manufacturers:

General Motors Corp., Oldsmobile Div., **L. F. Carlson**, Manager of Advertising and Public Relations, succeeding **V. C. Havens**, who has resigned.

Ford Motor Co., **Earl Severson**, appointed manager of newly established Industrial and Marine Div.

Ford Motor Co., **L. E. Briggs**, General Auditor.

Graham-Paige Motors Corp., **Edgar Kaiser**, Vice-Pres. and Gen. Mgr.; **Clay Bedford**, Vice-Pres. in Chg. of Manufacturing; **H. C. McCaslin**, Vice-Pres. in Chg. of Engineering. **James L. Cotter**, now acting treasurer, named a vice-pres.

Kaiser-Frazer Corp. and Graham-Paige Motors Corp., **Frank Link**, Sales Promotion and Adv. Mgr.

Chrysler Export Corp., **Mario Sein**, Asst. Adv. Mgr.

Continental Motors Corp., and Continental Aviation & Engineering Corp., **N. W. Hopkins** has been appointed Advertising Director for both companies.

Bendix Aviation Corp., Eclipse-Pioneer Div., **George A. Lewthwaite**, Sales Mgr., **R. P. Luce**, Asst. Sales Mgr. and **Charles A. Wolf**, Sales Engineering Service Div., **Dan S. Tilden**, head of consolidated Service Dept., **John J. McKenna**, Supervisor of Field Service and **Harold Peck**, Supervisor of Factory Service. **Frederic G. Muller**, Director of Public Relations and Advertising for both Eclipse and Pioneer Divs.

Bendix Aviation Corp., Bendix Products Div., **Fred H. Kroeger**, District Mgr. Service Sales Div.

Bendix Helicopter Inc., **Peter N. Jansen**, Vice-Pres. in Chg. of Operations.

Curtiss-Wright Corp., Propeller Div., **Don R. Woolf**, Chief Blade Design Engineer.

Kellett Aircraft Corp., **N. F. Vanderlipp**, Works Mgr. in charge of production activities.

Luscombe Airplane Corp., **Douglas W. Hayward**, Mgr. of Sales Dept.; **James L. Camp**, Mgr. of Sales Promotion Dept. and **William T. Wisener**, Personnel Mgr.

The Aviation Corp., **Carl H. Kindl**, Vice-Pres. in Chg. of Mfg.

Fairchild Engine and Airplane Corp., **Marvin J. Parks**, Export Mgr. with headquarters in Washington, D. C.

Fairchild Aerial Surveys, Inc., **Maurice Perrier**, Mgr., Eastern Div.

Westinghouse Electric Corp., **Gwilym A. Price**, elected President, succeeding **George H. Bucher**, who was elected Vice-Chairman of the Board of Directors and Chairman of Westinghouse Electric International Co.; **A. W. Robertson**, elected Chairman of Westinghouse Board of Directors.

Norton Co., Abrasive Div., **R. H. Cannon**, Merchandising Engineer.

The Perfect Circle Co., newly elected officers are as follows: **Lothair Teetor**, Chairman of the Board; **Ralph Teetor**, President; **Macy Teetor**, Vice-Pres. in Chg. of Engineering. **George W. Stout**, Sales Promotion Mgr., a newly created position embracing all phases of company merchandising policies and procedure.

General Motors Corp., New Departure Div., **Seth H. Stoner**, Asst. Chief Engineer in chg. of automotive and tractor applications.

Chandler-Evans Corp., **Richard M. Johnson**, Asst. Sales Mgr.

The Prest-O-Lite Battery Co., Inc., **Wm. E. Schneider**, Advertising Mgr.

Shuler Axle Co., **James F. Bleakley**, Vice-Pres. in Charge of Production.

The Firestone Tire and Rubber Co., New Products Dept. **Roger S. Firestone**, Manager.

The General Tire and Rubber Co., **A. W. Phillips**, Production asst. to **C. J. Jahant**, Vice-Pres. in Chg. of Operations. **John L. Mead**, Asst. to **C. J. Jahant**, in charge of staff activities. **Albert J. Teusch**, Asst. Director, Industrial Relations.

The Midland Steel Products Co., **E. P. Turner** and **LeRoy J. Fralick**, elected Vice-Presidents.

Wagner Electric Corp., **J. R. Rose**, Asst. Sales Mgr., Automotive Equipment Div. **H. H. Brandenburger**, Mgr., Automotive Parts Div. **G. B. Evans**, Plant Mgr. **C. W. Hesse** succeeds **Mr. Evans** as General Supt.

The B. F. Goodrich Co., **E. C. Shingleton** has been appointed to handle sales promotion programs on trucks, farm, off-the-road and industrial tires and tubes. **J. E. Gulick**,

(Turn to page 112, please)

Non-Union Ford Workers to Pay Union Dues in Canada

In an unprecedented move, Judge **Ivan C. Rand** of the Canadian Supreme Court and special government arbiter, recently ruled that all employees of the Ford Motor Co. of Canada, whether members of the union or not, must pay dues to the UAW-CIO. The order upheld the long standing contention of labor unions that non-union workers benefit from union gains and therefore should support the union financially. Non-union members, however, are not compelled to pay special assessments, nor are they forced to join the union. The arbiter also held that all employees have the right to participate in strike votes, regardless of whether they belong to the union or not. If the union calls a strike without having obtained a majority vote in favor, it is liable to suspension of the dues checkoff for from two to four months.

CALENDAR

Conventions and Meetings

- American Society for Testing Materials, Pittsburgh Spring Meeting Feb. 25-Mar. 1
- Pan-American Aircraft Exposition, Dallas Mar. 1-5
- Second Northwest Annual Airshow, Minneapolis Mar. 12-18
- The Amer. Helicopter Society, Phila. Mar. 14-15
- Amer. Soc. of Mechanical Engineers—Spring Meeting, Chattanooga Apr. 1-3
- American Management Association, Atlantic City, N. J., Packaging Exposition Apr. 2-5
- SAE Natl. Aeronautic Meeting, New York, N. Y. Apr. 3-5
- Midwest Power Conference, Chicago Apr. 3-5
- American Society of Tool Engineers, Cleveland Tool Engineers Exposition Apr. 8-12
- International Lighting Exposition, Chicago Apr. 25-30
- The Chamber of Commerce of the United States — Annual Meeting, Atlantic City Apr. 30-May 2
- Natl. Assoc. of Corrosion Engineers, Kansas City, Mo., Annual Meeting and Convention May 7-9
- Associated Business Papers, Hot Springs, Va., Spring Meeting May 22-25
- SAE Summer Meeting, French Lick, Ind. June 2-7
- Amer. Soc. of Mechanical Eng.—Detroit June 17-20
- SAE Natl. West Coast Trans. and Maint. Meeting, Seattle Aug. 22-24
- SAE Natl. Tractor Meeting, Milwaukee, Wis. Sept. 11-12
- SAE Natl. Transportation and Maintenance Meeting, Chicago Oct. 16-17

PUBLICATIONS

The first issue of **The Alloy Pot** since 1940, has been released by The New Jersey Zinc Company. The entire issue is a preview of the many zinc alloy die castings on the 1946 car models. Radiator grilles, hood ornaments, hardware, name plates, etc. are amongst the various items pictured and described.*

Vinylite Plastics—Elastomeric Compounds, is a profusely illustrated booklet released by Bakelite Corporation, which discusses molding and extrusion compounds, flexible sheeting and film, cloth coating compounds, and describes the properties which make these plastics valuable engineering materials.*

A new post-war general catalog entitled **Specification Index for Bristol Instruments** has been published by The Bristol Company. The catalog is No. W1800 and contains 24 pages of information on Bristol automatic controlling, recording and indicating instruments and gives several time and money saving hints. The booklet is illustrated with many line drawings.*

Bulletin No. 11-B has been published by Ajax Electrothermic Corp. and describes high-speed precision melting of alloy steels and other ferrous metals in Ajax-Northrup induction furnaces. Helpful hints in planning an efficient shop are included, and a table showing proper equipment to maintain any given production schedule.*

A new booklet, **Radar on Wings**, has been published by Philco Corporation. It tells how Philco airborne radar was developed and produced. Many interesting and unusual photographs are included.*

The Hobart Brothers Co. has released a folder announcing their complete, post-war line of arc welding electrodes. The pocket-size folder gives description, application, procedure, physical properties of deposited metal and sizes available for each type electrode in the new post-war line.*

A new line of arc welding accessories for the welding trade is announced in a new booklet by The Hobart Brothers Company. The booklet is DM-709.

Bulletin 45-A on **Rotameters** has been issued by Fischer & Porter Company. It is well illustrated and contains two pages of engineering recommendations for the types of Rotameters and materials of construction to be used in measuring flow rates of a great many difficult and corrosive fluids and gases.*

A 32-page illustrated catalog announcing the new standard **Rotocast Hydraulic Cylinders** and containing engineering data is offered by the Logansport Machine Co., Inc. Engineering developments and advanced features of the new line are included together with other Rotocast cylinder features and mechanical drawings of the 7 standard mounting types. Specifications and engineering data on available cylinder types are also included.*

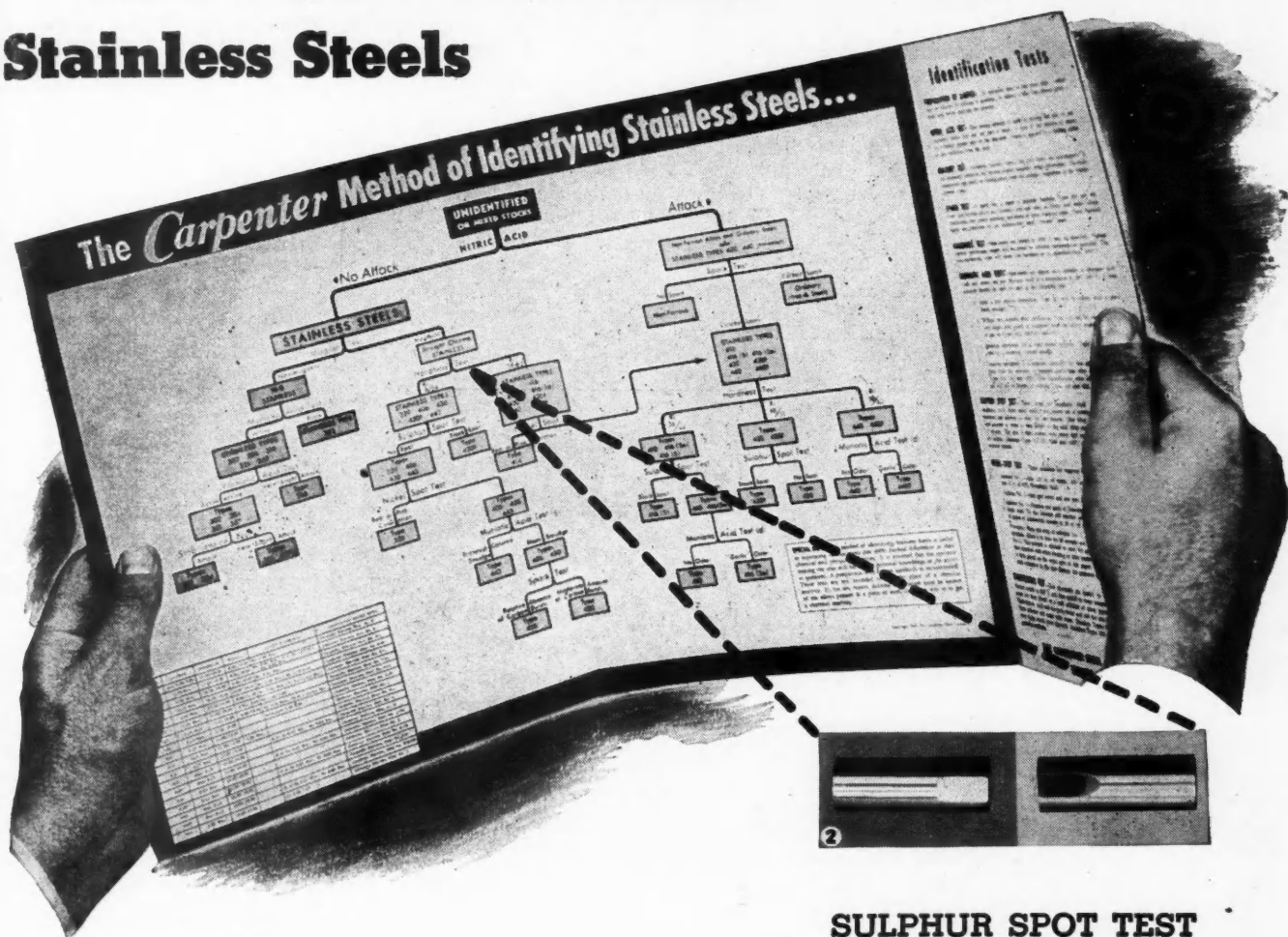
Protective Coatings Corp. has issued a complete and well-illustrated brochure of 16 pages on the application of **Aquastop** synthetic impregnated, waterproof, sealed case liners. It illustrates and describes the steps in applying Aquastop to shipping case panels, as well as method of sealing and describes physical characteristics and technical details resulting from tests.*

* Obtainable by subscribers within the United States through Editorial Dept., AUTOMOTIVE and AVIATION INDUSTRIES. In making requests for any of these publications, be sure to give date of the issue in which the announcement appeared, your name and address, company connection and title.

Ford Increases Wages

Ford Motor Co. has granted a 15 per cent wage increase to practically all employees not covered by the recent 18-cent-an-hour increase agreement between the company and the UAW-CIO. It was retroactive to Jan. 1 and will apply to approximately 19,000 hourly-rated and salaried employees.

To Help You Identify Stainless Steels



SULPHUR SPOT TEST

This is one of the 11 tests used in the "Carpenter Method of Identifying Stainless Steels".

Place three drops of Sulphuric Acid solution (one part Sulphuric Acid, three parts water) on a newly-ground spot of the specimen and allow to react for one minute. One drop of a 5% solution of Lead Acetate in water is then added to the acid drop and allowed to react for 15 seconds. The spot is then washed with water and examined. A positive test for Sulphur (Stainless Types 416 (S), 420F and 430F) is the presence of a black sulphide deposit.

YOU know the troubles a mix-up in Stainless stock can cause in heat treating, machining, stamping, welding or other fabricating operations. So it's important to you to have a quick method for identifying Stainless that may become mixed in stock.

The Carpenter Laboratories have developed a new and simplified chart for identifying various types of Stainless Steel. The Chart diagrams and explains the nitric acid test, magnet, spark, hardness, and muriatic acid tests, sulphur spot and nickel spot tests, and the stabilization test, and shows when and how to use each one. With this chart you can check the identity of Stainless Steels which may be in question.

Use it in your laboratory, to help your stockroom, warehouse or production department check on mixed stocks. To obtain a copy, simply fill out the coupon.

Carpenter STAINLESS STEELS

THE CARPENTER STEEL COMPANY

103 W. Bern St., Reading, Pa.

Without obligation, please send me your new chart for identifying Stainless Steels.

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

(PLEASE PRINT)

German Innovations

(Continued from page 38)

and the thin-walled light cylinder assembly, permitting efficient fresh water cooling, are contributing factors that make a bmep of 149 psi practical.

The reduction gear and clutch weigh 1220 lb, reducing the bare dry engine and supercharger weight to 8780 lb. This represents a ratio of 3.5 lb per hp. A multiple steel disk clutch in the reduction gear allows the propeller to turn freely when the engine is secured and the ship underway. Three helical bevel gears are mounted on a spider

fastened to the propeller shaft giving a 1.72 to 1 speed reduction.

A non-reversible centrifugal blower is driven through a 9 to 1 speed-up gear and can be engaged below 800 engine rpm through a hydraulic steel disk clutch. The air is cooled to 100 F, after leaving the supercharger, in a radiator-type intercooler to permit an increased charge of air with the same effect as explained previously for the heavy engines.

The chrome-nickel crankshaft is

forged with integral counterweights at Nos. 1, 5, 6 and 10 crank pins and polished all over. Eleven main roller bearings are lubricated by 11 individual plunger pumps, providing lubrication uniformly to all bearings under all operating conditions.

All the lubricating oil, fresh- and raw-water, transfer fuel-oil pumps are made reversible on a different principle for each of the four different types of pumps except the four Bosch fuel pumps which are driven by symmetrical cams. Fuel pump timing can be manually controlled by changing the drive coupling flange relationship on all four fuel pumps through a helical slide arrangement.

The camshafts have the two sets of cams joined by ramps so that the camshafts can be shifted axially, for reversing, without lifting the cam rollers. The camshafts are supported by roller bearings which ride on split outer races and have split cages, similar to the main bearings. No valve seats are provided, and the intake and exhaust valves are identical except that exhaust valve stems are sodium cooled internally. The exhaust valve guides are made of an unusual nickel-silicon-copper alloy, which should have good heat conducting and wearing qualities. Except for a few steel alloys such as used in the German reduction gear spiders, all the metals and their treatments are well known in this country. The finish of all the parts and the materials are of the best quality, indicating again the apparent limitless use of manpower.

The fuel oils and lubricating oil specifications are similar to the oils used by U. S. Armed Forces and no use of high cetane fuel was discovered. High cetane Diesel fuel up to 100 cetane was available in Germany as a by-product of several synthetic fuel processes, but the engines to take advantage of the properties of this fuel had not yet been developed.

Willys Announces New Passenger Vehicle

A new type of passenger vehicle, "combining Jeep ruggedness with station wagon utility and comfort," is being readied for production this spring by Willys-Overland Motors, according to an announcement by James D. Mooney, president. The utility car is the second step in the company's four-part product program which started with the civilian Jeep; it will be followed by a line of commercial trucks and completely new passenger cars.

William T. Morris

William T. Morris, 61, president of the American Chain & Cable Co., Bridgeport, Conn., and president or director of several other business establishments, died Feb. 6 at Memorial Hospital, New York, N. Y., after a protracted illness.

What Motor Applications INTEREST YOU?

Here are a few of the more than 3,000 applications for which Lamb Electric Motors have been used:

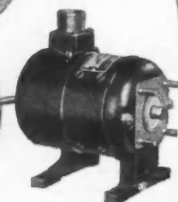
AIRCRAFT COMPONENTS
BLOWERS
BUSINESS MACHINES
COMMERCIAL APPLIANCES
ELECTRONIC CONTROLS
GARAGE EQUIPMENT
HOUSEHOLD APPLIANCES
INDUSTRIAL MACHINES
PORTABLE DEVICES
PORTABLE ELECTRIC TOOLS



Compactly designed motor developed for metering pump and special instrument service.



Typical applications for this motor: industrial vacuum cleaners, agitators, silos and colloid mills.



Intermittent high torque motor with low weight factor, developed for aircraft service.

If you are developing a product in any one of these classifications, why not consider a special application motor to obtain maximum performance, low weight, improved compactness, and appearance? Our 31 years' experience designing and building small motors should prove valuable to your engineering department.

THE LAMB ELECTRIC COMPANY

KENT, OHIO

Lamb Electric
Black & Decker Electric
FORMERLY

SPECIAL APPLICATION
FRACTIONAL HORSEPOWER **MOTORS**

SHORT CUT TO MASS PRODUCTION BALANCING of Crankshafts, Impellers, Armatures, Etc.

Get all the facts about
OLSEN STATIC-DYNAMIC
BALANCING EQUIPMENT



Here between two covers are all the facts about the complete line of Olsen E-O Balancing Machines.

Bulletin No. 26 details construction and operation of Olsen equipment which is widely used and preferred for its simplicity, accuracy, and ease of operation.

If balancing is one of your problems, or, if you'd like to know how to improve your product by balancing, fill out and mail the coupon below and we'll put a copy of Olsen Bulletin No. 26 in the mail to you.

TINIUS OLSEN TESTING MACHINE CO.
522 NORTH TWELFTH ST., PHILA. 23, PA.

Balancing Machines

AND PHYSICAL TESTING EQUIPMENT



Representatives: PACIFIC SCIENTIFIC CO., Los Angeles, San Francisco, Seattle
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A2

522 North 12th Street, Philadelphia 23, Pa.

Please send me your Bulletin No. 26 on Olsen Balancing Machines.

NAME.....

TITLE.....

COMPANY.....

ADDRESS.....

CITY.....STATE.....

Airbriefs

By Henry Lowe Brownback

Carburetors

About a year ago AIRBRIEFS went into the question of carburetion and

deplored the fact that the late type of injection carburetors was not available for small engines. It is with great satisfaction that I read the advertisement of one of our leading carburetor



Accurate control of motor temperature—with a DOLE Thermostat in the cooling system—is an effective aid in maintaining car performance at high levels—at all seasons. Controlled cooling gives quicker warm-up—with a positive reduction in crank case dilution . . . and definite savings in gas, oil and motor wear.

DOLE

Thermostats

in a range of types for every car

THE DOLE VALVE COMPANY

1901-1941 Carroll Avenue, Chicago 12, Illinois

LOS ANGELES

DETROIT

PHILADELPHIA

manufacturers that injection carburetors will be made for engines of 40 hp and up. I believe that this will greatly improve the action of small engines and add a needed factor of safety on such powerplants.

A Problem

It seems certain that, in large sizes, some gas turbine or combined turbine and jet powerplants will replace the familiar piston engine just as the old ship's multiple expansion reciprocating engine has been replaced by the smooth running turbine. This seems to be the opinion in Britain as one sees turbine or jet engines offered by the principal makers of piston engines. Here it is different and the newer propulsion units are being made by the manufacturers of steam turbines. Does this mean that the makers of piston engines are ultimately to find their market gone and will have to fold up after building up years of good will in aviation and turn over the really profitable end of the business to the big groups now making the turbine and jet units?

New Materials

Many advances are being held up pending the perfection of new materials or improvements in the manufacture of known materials which will permit their use in machines and not just in the laboratory. Among these is the combined plastic and glass sheets about which we wrote several years ago. This strong, light material has been made so far, for the most part, in sheets by weaving glass fibers and then impregnating the sheets with plastic. A late development is the molding of this material into fuselages using the fibers and plastic molded into sheets for the outside and inside coverings and using a honeycomb of the same material in the middle of the "sandwich." This improved technique produces a smooth fuselage with no bracing and one which cannot corrode and should be vibration proof. Another place where improved non-metallic materials are being tried is the blading of gas turbines. Until recently it took all of the power developed by a gas turbine to run the compressor but with improvements in metallurgy and axial compressor design some power was left over making the job practical as a power plant. This "left over" power depends for its magnitude upon the temperature at which the turbine can operate. Experiments using either ceramic covered or ceramic turbine blades give great promise for higher powers and the use of the exhaust for jet propulsion gives even more power recovery. Improved materials, metallic or ceramic, in combustion chambers and turbine units can easily revolutionize the gas turbine and with it the entire aviation powerplant picture.

(Turn to page 110, please)

YOU DON'T  HAVE TO
RE-DESIGN

THE VEHICLE TO APPLY

VICKERS Hydraulic Power Steering

Vickers Hydraulic Power Steering requires minimum space and can be located where it does not interfere with other apparatus. In nearly all cases it is easily applied to existing vehicle design with only a few simple alterations.

The hydraulic power cylinder is connected to the drag link at one end and the chassis frame at the other; it is controlled by the pitman arm. The existing steering gear is not altered. Hence, Vickers Power Hydraulic Steering is easily applied either as original or as optional equipment.

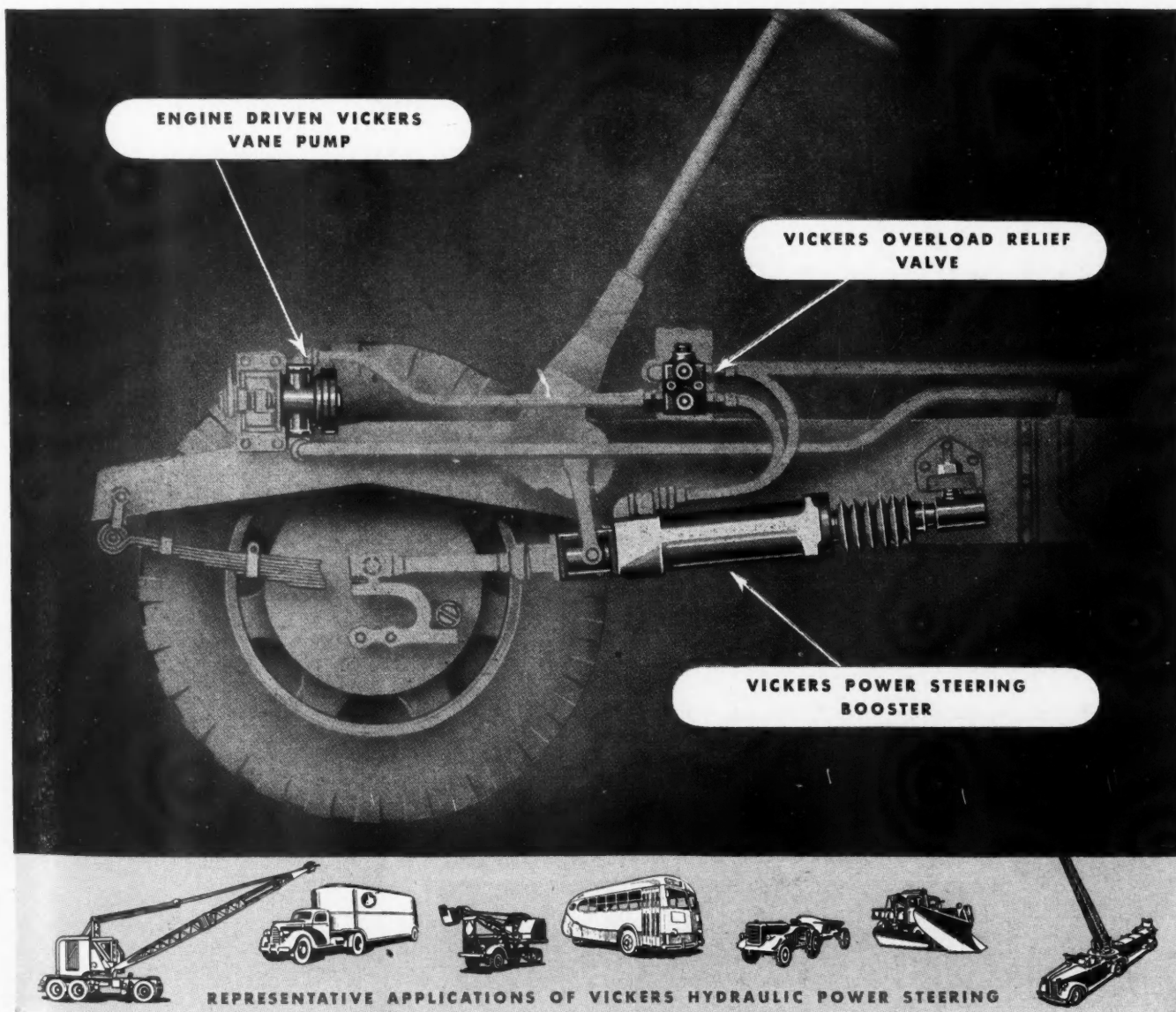
Steering is finger-tip easy—instantly responsive—and no road shocks can get to the steering wheel. Overload

protection and lubrication are both automatic. Fifteen years of successful operation on trucks, buses, and road machines have proved the value of Vickers Power Hydraulic Steering. Write for Bulletin 44-30.

VICKERS Incorporated

1428 OAKMAN BLVD. • DETROIT 32, MICHIGAN

Application Engineering Offices: CHICAGO • CINCINNATI • CLEVELAND
DETROIT • LOS ANGELES • NEWARK • PHILADELPHIA • ROCHESTER
ROCKFORD • TULSA • WORCESTER



New Production Equipment

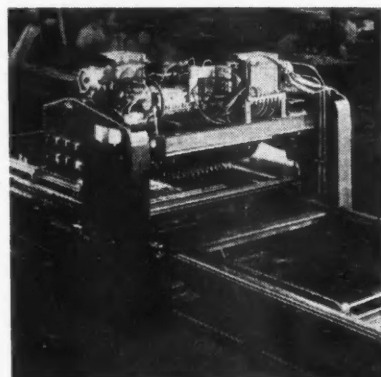
A NEW Ultra-Speed welder control unit, designed and built by the Progressive Welder Co., Detroit, Mich., is said to permit automatic assembly welding rates up to 900 spots per minute.

It is the heart of all new Progressive Ultra-Speed welding machines. Distributing welding current to a single

or to groups of welding points successively by means of a screw driven carriage that depresses push rods to engage contacts in the same manner as one would run a finger over a piano keyboard. At the same time another element of the carriage engages adjustable stroke plungers to control individually the length of time the welding

current flows for each weld. All welding points bear on the work simultaneously under welding pressure before the first weld is formed and remain until the last weld is completed, eliminating the separate "squeeze" and "hold" times usually required for each weld. Thus 20, 50, 100 or more joints can be made in slightly more time than the total of the individual "weld times"—at a few hundredths of a second each.

Machines can be built to accommo-



Ultra-Speed welder unit

BRAKE LINING PROBLEMS?

Come to **GRIZZLY**

REG. U.S. PAT. OFF.

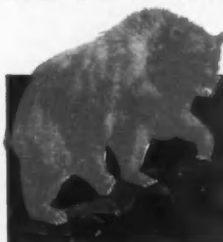


Thirty years experience in the manufacture of brake lining has provided Grizzly with a priceless background for solving brake lining problems. The solutions to countless problems of widely divergent natures have come about through Grizzly research and constant alertness to

new developments in the brake lining field.

Leading engineering, production and purchasing men realize the importance of Grizzly's years of manufacturing experience—recognize Grizzly as a source for fine quality molded brake lining in the competitive price range.

Engineers are invited to the new brake lining engineering laboratory at Paulding—another achievement in Grizzly's alert, progressive operation.



GRIZZLY MANUFACTURING COMPANY

PAULDING, OHIO

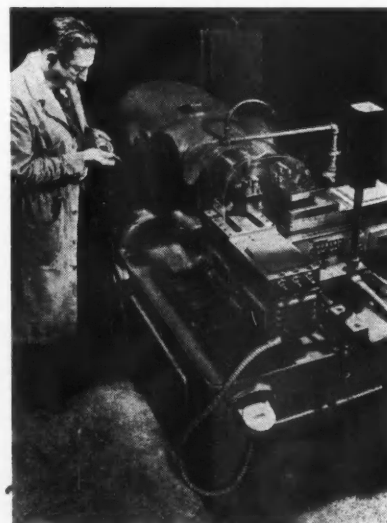
PLANTS AT PAULDING AND BELL, CALIF.

Warehouse Stocks in Principal Cities

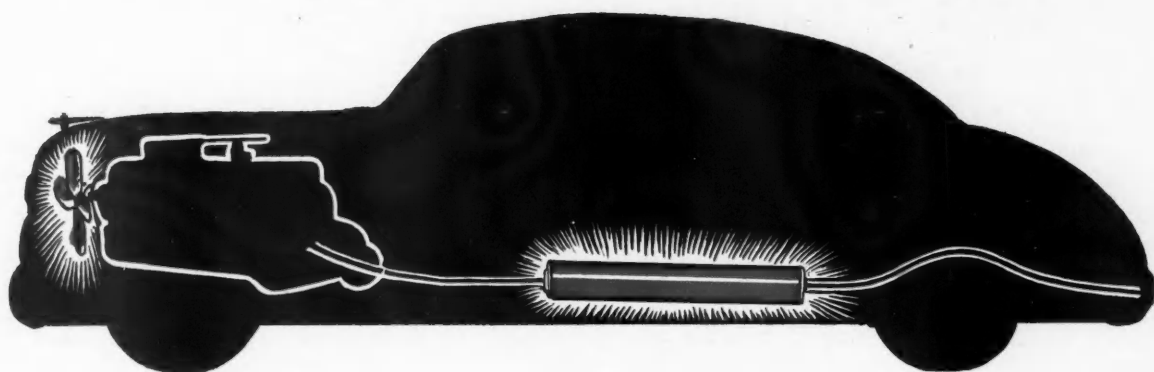
date an almost unlimited range of weld spacings and locations. The welding guns can be arranged in single or multiple rows, circles, steps, curves, etc., either closely spaced or spanning the full width of large panels. Individual timing of each welding gun permits the spot welding of different thicknesses of metals during one complete operation.

A NEW turning machine, the Uni-Matic, is announced by the Monarch Machine Tool Company, Sidney, Ohio, for turning, facing, and boring operations on a production basis with extreme accuracy. It consists essentially of two members (1) a simplified version of the conventional lathe base and headstock, with change gears, motor, and associated drive mechanism, and

(Turn to page 58, please)



Monarch Uni-Matic

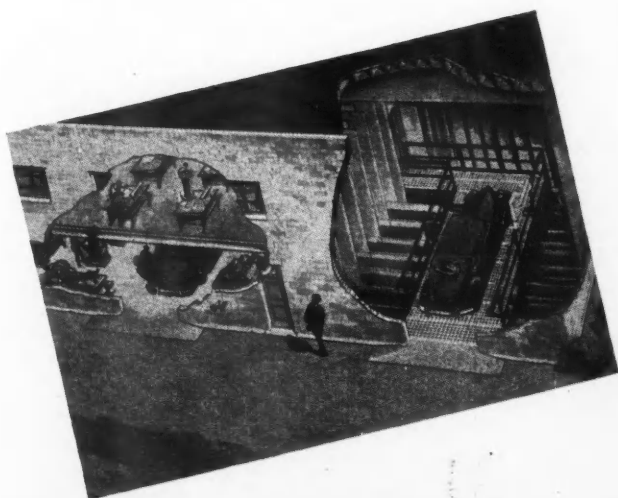


From **BEGINNING...**
to **END...**

OF THE COMBUSTION PROCESS

... from fan to muffler ...

efficient work and silent results give added competitive sales value to Hayes-equipped cars and trucks.



Pioneers of engineered improvements in fans and mufflers our "know how" will fit your designs.

Only one of its kind in the automotive industry, our new SOUND and WIND TUNNEL LABORATORY is another asset to the industry. Sound levels reaching both above and below human audible ranges are researched for fan and muffler improvements in keeping with new car and engine design.

HAYES INDUSTRIES INC.
JACKSON, MICHIGAN

FANS • MUFFLERS • MOLDINGS • OTHER PARTS

(2) from one to three specially designed individually motor-driven tool slides which are mounted on Tee-slotted swiveling bases, permitting turning, facing, and boring operations from almost any angle.

These tool slides, known as "Uni-Mats," are basically individual motor-driven compound rests which can be grouped about the spindle in whatever arrangement will best facilitate the application of the cutting tools to the work.

Each "Uni-Mat" is equipped with an electrically controlled a-c motor to traverse the main slide of the device. That portion of the automatic cycle con-

cerned with the rate of feed is controlled on a single purpose Uni-Mat by sets of change gears. The Uni-Mat is also furnished driven by a d-c motor so that with two sets of change gears, it is possible to secure the entire feeding range. The Uni-Mat slides, regardless of their type of initial drive, are built in two models, one equipped with tool relief, the other with a solid top slide.

The only connection between the one or more Uni-Mats with which the new Uni-Matic is equipped, is the cable which carries the control circuits. The electronic equipment is in a separate control cabinet. Since the only connec-

tion between the Uni-Mat slide, which moves the tool through the automatic cycle, is this one cable, it is possible to position each unit in exact accordance with the work. The only moving slide on the Uni-Mat is directly below the cutting tool and the micro switches which control the functioning of this automatic cycle of the slide are mounted in a direct one-to-one relation to the motion of the tool slide.

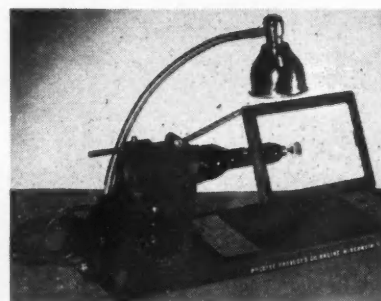
Since the Uni-Mats are all electrically controlled, several timing devices have been utilized to maintain any required relation between the cycle of one Uni-Mat, the cycle of a second and a third. After the micro switches have been positioned to control the cycle, it is possible to re-time the slides with reference to each other so that there will be no lost time between the functioning of the individual Uni-Mats. This close timing is made possible by the changing of the electrically-interlocked timers.

Another Monarch development is the "Mona-Matic" lathe, a semi-automatic cycle machine which can be used for manual or semi-automatic first and second operation work, providing an unusually wide range of spindle speeds. This machine is offered for the many short run or moderate sized runs typical of the requirements of automotive plants and particularly in parts plants.

In addition, the company offers a new edition of its EE 10-in. Sensitive Precision Toolmaker's lathe, now capable of higher speeds and feeds; a universal toolmaker's lathe; a 10 in. Speed-Matic manufacturing lathe with power feed ram type turret, designed to handle small turning work in lots of 25 to 500 or more pieces; and a new type of universal toolmaker's lathe with special features for mold makers.

A SMALL high-speed lathe for use on bench or table has been developed by Precise Products Co., Racine, Wis., for grinding, finishing, and polishing small products and parts made of steel, non-ferrous metals, plastics, glass, wood and other materials.

Powered by the manufacturer's Precise-35 electric grinder and hand tool, the lathe unit has built-in speed control allowing a range of working speeds from zero to 40,000 rpm. By turning a control dial speeds can be continuously adjusted from standstill to top speed. The power unit can be (Turn to page 60, please)



Precise high-speed lathe



Faithfully Serving
nearly half the automobiles, trucks
and tractors in operation today.

*For
THAT VITAL SPOT
where
POWER TAKES HOLD
OF THE LOAD!*

BORG & BECK

The Standard Clutch



BORG & BECK DIVISION
BORG-WARNER CORPORATION

CHICAGO ILLINOIS

"Perfect" PROTECTION UNDERGROUND



The bearings in mining machinery such as in this Sullivan Coal Cutter, when in use in the coal mines, are subject to attack by two of the worst enemies that bearings ever encounter—Grit (coal dust in this case) and Moisture. To survive, such bearings need the best protection it is possible to give them.

It is significant that the Sullivan Machinery Company, with its 60 years of

experience in the coal mines, and its highly enviable reputation as a producer of mining machinery, uses Chicago Rawhide "Perfect" Oil Seals to protect the vital bearings in its 10-RU Trackless Coal Cutter.

"Perfect" Oil Seals are protecting vital bearings in all kinds of mechanical equipment. Get our engineers' recommendations on your sealing problems.



CHICAGO RAWHIDE MANUFACTURING CO.

1310 ELSTON AVENUE • CHICAGO, ILLINOIS

Philadelphia • Cleveland • New York • Detroit
Boston • Pittsburgh • Cincinnati

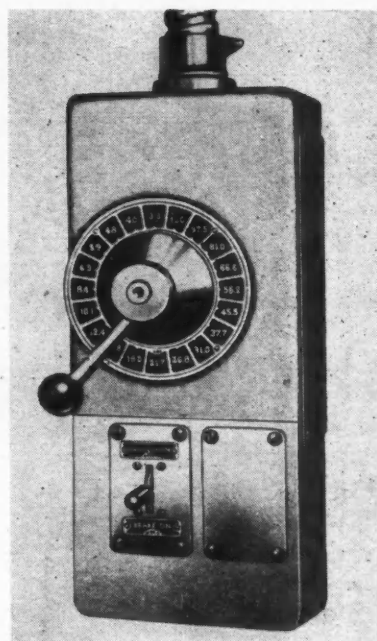
66 Years Manufacturing Quality Mechanical Leather
Goods Exclusively and now Sirvans Synthetic Products

detached and used separately as a hand tool for grinding, milling, deburring, finishing and polishing.

The lathe stand is cast of solid aluminum and finished in black crackle. Two recessed compartments with oak covers provide storage space for rotary tools. Adjustable safety glass shield protects operator while lamp on flexible arm illuminates entire operating field.

AN EXCLUSIVE feature of all Bullard Cut Master vertical turret lathes manufactured by the Bullard Co., Bridgeport, Conn., is the Pendant Control, which is said to provide a high degree of control and operating effi-

ciency. A swinging arm carrying the pendant is mounted on top of the machine high enough to permit full clearance of vertical heads when they are in maximum high position. The pendant is located at a convenient operating height. The arm may be swung from the right side of the machine to any convenient point over to the left side of the machine, thereby giving full operating control at all times. The design is a departure from conventional controls of this type, inasmuch as speeds are selected by means of dialing. When the machine is in operation and a speed change is desired, the switch lever is thrown into brake posi-



Bullard Pendant Control

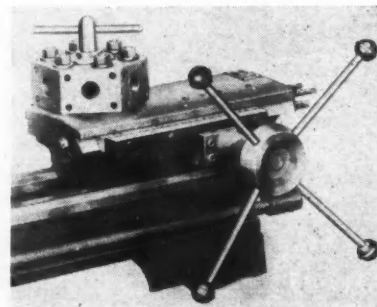
tion, the change of speed dialed and the lever thrown back into clutch position. Gears are quietly and almost instantaneously shifted through electrically-controlled, hydraulically-operated mechanisms. Self-interlocking design provides protection for the proper selection of gears.

There are many cases which require jogging of the table for positioning and indicating purposes. This is accomplished through the use of the switch lever which will jog and position the table for any fraction of a revolution.

ENCO MANUFACTURING CO., Chicago, is manufacturing a new bed turret for lathes up to 14-in. swing. Known as the Hexturret, it uses double steel drive gears and double racks for equalizing the feed of the tool on the work. This twin drive also keeps the turret in alignment and minimizes wear. Double gibs of the heavy duty type are employed, providing for an adjustment from either the front or back dovetail.

All parts of the indexing mechanism are hardened. Extreme precision of indexing is claimed through the use of hardened and ground tapered bushings in the turret head, and hardened and

(Turn to page 62, please)



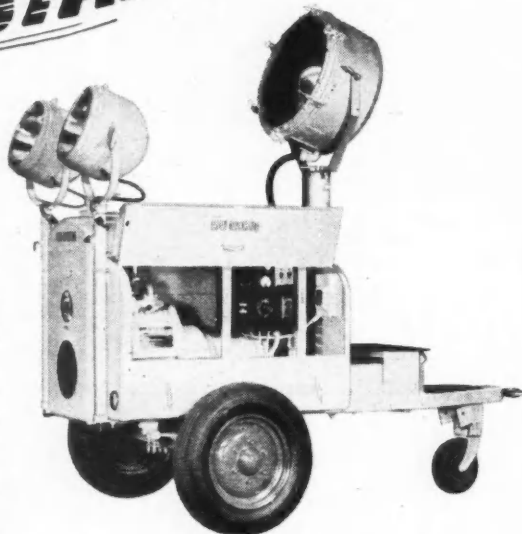
Bed turret made by Enco Manufacturing Co.

NITE HAWK



5 IN 1 MACHINE

1. Designed especially for starting all airliners, cargo and private planes. Produces 500 amperes of electric power—both 12 or 24 volts.
2. Lights runway. Seven million candle power adjustable searchlight throws 1½ miles of light.*
3. Lights apron, ramp . . . Ideal for localized operations lighting—has two 80,000 c.p. adjustable floodlights.
4. Provides emergency power . . . 110 or 220 volts, 60 cycle, a.c. current.
5. Inflates tires—gives you compressed air at 80 lbs.



*All models can be supplied with combinations of searchlights and floodlights.

The Nite-Hawk Aero-Starter performs all services necessary on an airfield at a fraction of the normal investment. Portable, engine-driven, it operates independently of other power sources. Investigate this money-and-time-saving, all-purpose machine.

Write for Bulletin NH12A

Desirable territories open for factory representatives. Write.



Lister-Blackstone
INCORPORATED 6619 W. MITCHELL STREET, MILWAUKEE 14, WIS.

MAKERS OF PORTABLE NITE-HAWK AERO-STARTERS, SEARCHLIGHT AND FLOODLIGHT UNITS
ALSO DIESEL ENGINES AND DIESEL-ELECTRIC POWER PLANTS

Good Morning!

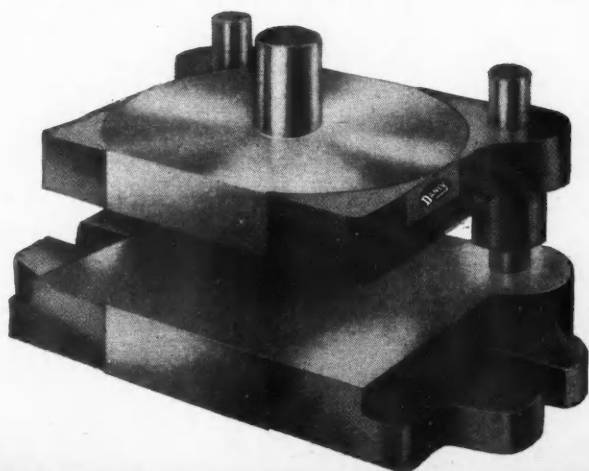


Back of the Bride's Breakfast Table **STANDS PRESS PRODUCTION**

Metal stampings produced in modern high speed presses will speed the new electric appliances to the household.

The known dependable accuracy of DANLY PRECISION DIE SETS will speed your civilian production in die making and stampings production for household utilities—or any type of press production.

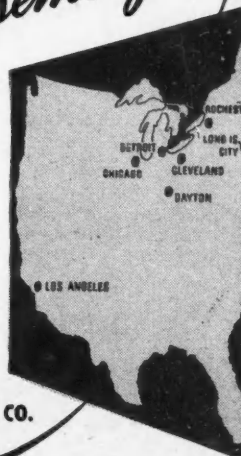
DANLY MACHINE SPECIALTIES, INC.
2100 South 52nd Avenue • Chicago 50, Illinois



DANLY *National Assembly*

Call Danly

- MILWAUKEE 2
111 East Wisconsin
- DETROIT 16
1549 Temple Avenue
- CLEVELAND 14
1550 East 33rd Street
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990 East Monument
- ROCHESTER 4
16 Commercial Street
- PHILADELPHIA 40
3858 Pulaski Avenue
- LONG ISLAND CITY 1
47-28 37th Street
- DUCOMMUN METALS & SUPPLY CO.
4890 South Alameda, Los Angeles



DIE MAKERS SUPPLIE

DANLY DIE SETS

Welded Steel Fabrication

CHANGING TIMES SHOULD BE SUCCESSFUL TIMES FOR EXECUTIVES!

Today, war worries have been succeeded by an atomic turmoil. Far-reaching changes have always followed wars—and the man who has kept pace always comes out on top.

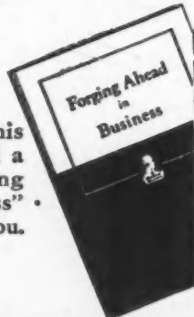
Come what may, one need is never completely filled—the need for competent executives to direct business and industry. In tumultuous times like those of today, this demand multiplies. Right now, the outlook for ambitious men is brighter than ever before—if they have the training to take advantage of opportunities.

The training needed is not narrowly specialized, but goes broad and deep, probing the basic principles that underly *all* business. It provides the knowledge that enables men to direct the activities of others not in one department or one kind of business, but in *any* business. It supplies the "know how" that enables top executives to manage *any* business.

How to get such executive training

Training of this kind is provided by the Modern Business Course and Service of the Alexander Hamilton Institute. The Course covers the four major functions of business—Production, Marketing, Finance and Accounting. It turns out not accountants, or salesmen or production men, but *executives!*

Fill in and mail this coupon today, and a free copy of "Forging Ahead in Business" will be mailed to you.



Takes months instead of years

This knowledge takes years to acquire by ordinary methods. Through Institute training, the process is concentrated and thus finished in a matter of months. It does not interfere with a man's present position, being taken at home, during spare hours. More than 430,000 men have subscribed; many call it "a turning point in their lives."

Many prominent contributors

One reason why the Institute Course is so basic, thorough and scientific is found in its list of prominent contributors. Among them are such men as Thomas J. Watson, President, International Business Machines Corp.; Frederick W. Pickard, Vice President and Director, E. I. du Pont de Nemours & Co.; Clifton Slusser, Vice President, Goodyear Tire & Rubber Co., and Herman Steinkraus, President, Bridgeport Brass Company.

"Forging Ahead in Business"—FREE!

You can read the Institute's stimulating story in the 64-page booklet "Forging Ahead in Business." Convenient, time-saving, it is offered without cost or obligation. Simply fill in and mail the coupon!

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Position.....
Home Address.....

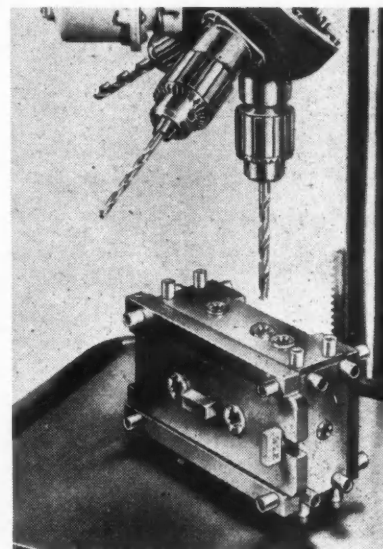
Alexander Hamilton Institute

ground tapered index pin and pin sleeve.

The versatility of this turret is increased by the Hexturret head which permits mounting flanged tools and tool holders. Other features include clearance of the lathe saddle wing for work close to headstock; a safety clamp to prevent "crawling" of the turret, and hardened stop screws.

CHICAGO DRILLET CORP., Chicago, Ill., is introducing a line of Drillet box jigs. It is said that these new units can be used in all phases of drill press operations such as drilling, reaming, counter boring, counter sinking, spot facing, tapping etc. They are available in 150 different sizes, square and rectangular, to accommodate all variations and ranges of shapes and sizes up to six-in. capacity.

Another advantage claimed for the



Drillet box jig

Drillet is the fact that it is possible to use the jig on all of its six sides, thus taking advantage of its full capacity. This is accomplished in Drillet box jigs by means of the removable sides together with the thumbscrew and leaf arrangement.

In operation, turning the thumbscrew and raising the leaf are all that is necessary to open the jig to receive a part. After the part has been placed in the jig and properly clamped, the leaf is brought into position and locked by the thumbscrew.

DESIGNED for "hyper-drilling (greatly increased speed in mass production drilling) a new type drill has been brought out by the Republic Drill and Tool Co., Chicago. Laboratory tests and production drilling are claimed to indicate tremendously faster penetration and greater hole accuracy with this new type drill, which Republic has named the "Jet" drill, and its accompanying "Jet" director.

(Turn to page 64, please)

A complete **WATER PUMP** *service* FOR YOUR NEW PRODUCT.... FOR IMPROVING PRESENT MODELS



Automatic
SHAFT SEALS
for All Requirements
AUTOMOTIVE
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Manufactured by



Schwitzer-Cummins will produce a FINE SEAL—a FINE IMPELLER—or a COMPLETE PUMP for you and all at a decided advantage in the performance of your product.

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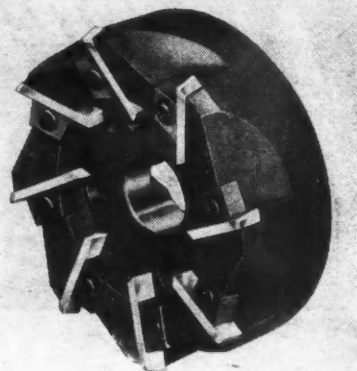


Republic Jet drill and Jet director

Republic ascribes the performance of the new "Jet" drill to three factors. First, the use of a great volume of coolant under high pressure. Second, high spindle speeds and feeds. Third, an entirely new principle in drill design.

KENNAMETAL, INC., of Latrobe, Pa., has developed a new type of milling cutter, called the "Universal" face kennamill, which consists of a precision built heat treated steel body, or tool holder, with a set of detachable solid Kennametal blades—as many as there are inches in the cutter diameter—mechanically held in position.

Five standard sizes are now available; 4 in., 6 in., 8 in., 10 in., and 12 in. diameter. Blades for these are of the same cross section, and when shortened by regrinding, can be used in smaller cutters successively. They are "formed" at both ends, and can be used in either right or left hand cutters.



Universal face Kennamill

The face mill can be adapted for milling different materials simply by interchanging blades. Those having the proper grade of carbide and suitable cutting angles are selected and inserted.

YOUNG ARBOR CO., Cleveland Heights, Ohio, is introducing a roller clutch expanding mandrel known as the Young precision mandrel. Work placed on the mandrel is automatically locked in place, ready for cutting tool, grinding wheel, deburring or polishing operations.

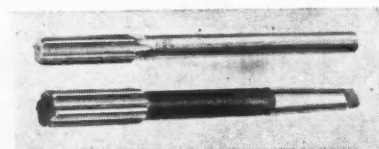


Young precision mandrel

Extreme cutting pressure results in tighter holding of the work. Material worked under heavy pressure is said to release as easily and quickly as under a deburring operation. No auxiliary power is required to expand a Young mandrel.

CARBIDE tipped solid reamers with the carbide tips extending the full length of the fluted section of the tool have been placed on the market by the Super Tool Co., Detroit, Mich.

The new reamers are said to be more



Carbide tipped reamers made by the Super Tool Co.

effective through the virtual elimination of wear on the flutes back of the cutting section. Scoring or galling is reduced to a minimum, particularly when reaming in cast iron or other abrasive materials.

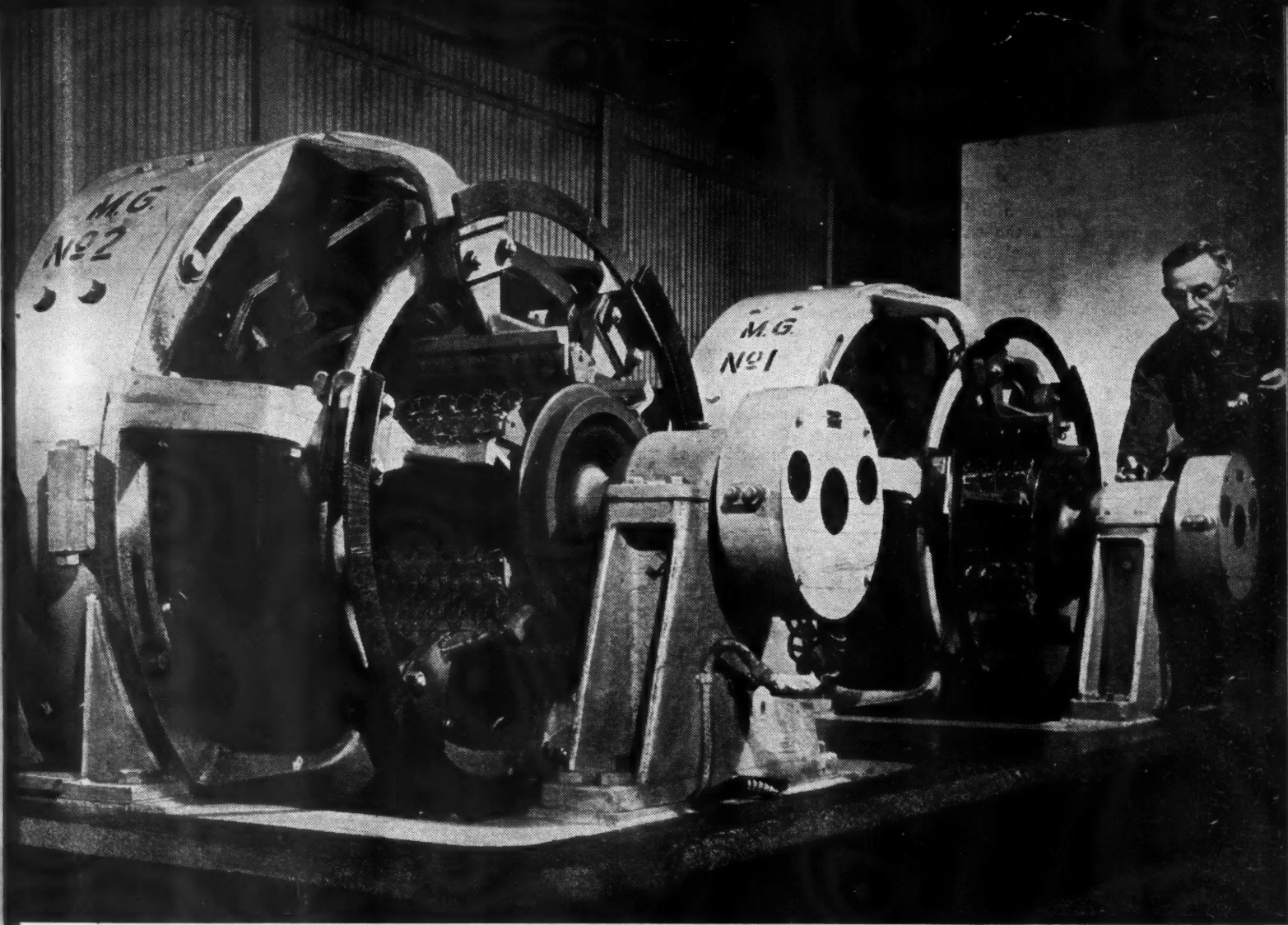
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BEARINGS RUN *10° Cooler*

SOLNUS OILS...

End High Bearing-Temperatures in Power-Plant

A Sun Engineer was called to a plant where the generator-bearings were running hot, and where oil was being thrown onto the generator-coils. Possible shutdown was foreseen if the oil-throw continued.

After studying the problem, the Sun Engineer recommended a change to a Solnus Oil. With this oil in service, the oil-throw problem was permanently licked, and bearing-temperatures dropped.

This case is just one of hundreds in the Sun Oil files . . . cases in which Sun Engineers and Sun products have teamed up to solve problems, increase production, avoid shutdowns.

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Testing of Piston Materials

(Continued from page 23)

limits from such data. The same is the case when the endurance load, obtained from stationary load tests, is used as a computation agent in its form in a time-elongation-limit curve. If the endurance load and the average tensile strength are simultaneously considered as a means of guidance for finding a proper alloy, such data will give fairly good results, even though no safe forecast can be made with regard to the actual behavior under practice conditions when the overload fac-

tor springs up. This is possible according to the diagrams of Fig. 8, as shown by the varying slopes of the upper limit curves.

Comparison of diagrams illustrates the influence of certain alloying components, such as copper and nickel, on the strength properties under overload conditions at higher temperatures. If these alloying components are generally reduced in the percentage at which they are present in the alloy, a rapid reduction of the corresponding dia-

grammatical region is observed. Only a planned examination of piston alloys with varying contents of alloying components can clear this up to satisfaction. The influence of the casting structure on performance is remarkable. Alloy C₂ as compared to C₁, the latter being extruded and the former being die cast, represents a wide difference due to this differentiation. In the die cast structure the endurance load is higher, while the average tensile strength is lowered, which approximately equalizes the strength areas. The alloy B₂, a particularly fine-grained casting of great density, obtained by a special casting process, shows improved properties over alloy B₁, which is extruded. The balance here is greatly disturbed when compared with the balance of the alloy C₁ to C₂.

These examples illustrate the importance of strength diagrams as comparable means of judgment for alloys under high temperature exposure. However, if the diagrams are intended to be used for determining shape formations, some basic problems result. These cannot be answered immediately and without due consideration of other factors which influence working in practical applications. Mechanical and heat influences and conditions are so different and manifold, that a general rule could not be determined as a guide for evaluation of these influences within this paper and testing procedure, even though the conclusion can be reached that a piston of alloy A would be superior to a piston of alloy B₁; and a piston of alloy B₁ would behave better than one of alloy C₁. The question of whether the diagram of alloy C₁ would be preferable to that of alloy C₂, or which is preferable for elimination of fractures and undesirable deformations, remains undecided. It would be desirable to carry out additional experiments under load in practice, using alloys of differing strength range, so that in the future such diagrams might be useful as a basis for forming and shape specifications of pistons. It is believed that this will result in a diagram which makes an even more complete evaluation of an alloy possible, so that the limits of safety can be reached. Such a diagram would also serve as comparison data for newly developed alloys.

Simplified endurance-load diagrams showing the creep limits, provide a way to evaluate, and find true-to-requirements piston alloys. However, one single value, for instance, the average tensile strength at higher temperatures, or the endurance load from a time-elongation-limit curve, is insufficient as a basis for evaluation of a piston alloy or any material. It is recommended, in conjunction with practical tests, that one single diagrammatical limit unit be established, which will suffice for practical application requirements and will form a basis for the evaluation of newly developed alloys.



Air turbulence built up by fan action of the mounting brackets greatly reduces torque loss due to heat and results in a cool operating, trouble-free clutch . . . one of many engineered features that contribute to the advanced design and performance of the Auburn Spring Loaded Clutch.



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DIVISION OF ATWOOD VACUUM MACHINE COMPANY,
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Harris COMPRESSED-RUBBER Joints require no lubrication, operate noiselessly and practically without wear, cushion shocks and absorb vibration. They are applicable to all sorts of equipment and we have supplied industry with millions of these joints.

If you have a wear or noise problem in connection with any oscillating joints, we welcome the opportunity to furnish the answer.



HARRIS PRODUCTS CO.
CLEVELAND 4, OHIO, U. S. A.

Motor Fuel Consumption

(Continued from page 44)

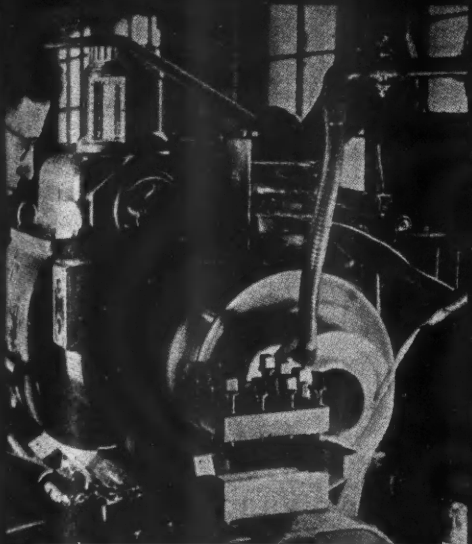
stantial decrease in motor-fuel consumption in the Eastern States during the same period was the result of a rapid succession of new restrictions. On November 22, 1942, the value of "A" coupons was cut from 4 to 3 gallons. On December 21, the value of "B" and "C" coupons was reduced from 4 to 3 gallons. In addition, temporary local shortages of motor fuel probably had a considerable psychological effect. On January 7, 1943, the first pleasure-driving ban was instituted and continued in effect until March 3. On March 22, the value of "A" ration coupons was reduced to 6 gallons per month by extension of the period for which the coupons were valid.

Fig. 4 demonstrates the relative effect of wartime conditions on the rate of motor-fuel consumption in the eastern, central, and western areas. The effect was greatest in the East, less so in the central area, and least in the western area. The decrease in consumption, however, was substantial in all three areas. While the relative decrease in motor-fuel consumption was greatest in the Eastern States, it will be recalled that motor-vehicle registration in that area also showed the greatest decrease. The curves in Fig. 4 do not reflect the fact that on a per-vehicle basis the relative changes between areas were fairly constant after November 1943.

After 1942 the peaks and valleys of seasonal consumption were minimized in all areas. The seasonal fluctuations which continued to be observed in total motor-fuel consumption were largely attributable to nonhighway uses, and these are not reflected here.

The State motor-fuel records, on which the data presented here are based, vary greatly in detail but are remarkably uniform in important aspects. The compilation of motor-fuel statistics, particularly with respect to total gallonage, is of a nature that justifies a high degree of confidence in their accuracy. As much cannot be said, however, for the segregation between highway and nonhighway use of motor fuel in some of the States. There are indications that a large amount of gasoline actually used on the highways was claimed to have been used for nonhighway purposes in order to evade State taxes. Liberal issuance of agricultural motor-fuel rations during the war may have encouraged users to claim use of much gasoline for agricultural purposes which was actually used on the highways.

State revenue from motor-fuel taxes followed almost exactly the curves of highway motor-fuel consumption. The curves in Fig. 3 may be used to demonstrate the trend in net State motor-fuel tax receipts.



ULTRA-SPEED PHOTOGRAPHY shows action too fast for the eye to follow by stretching split seconds into minutes.


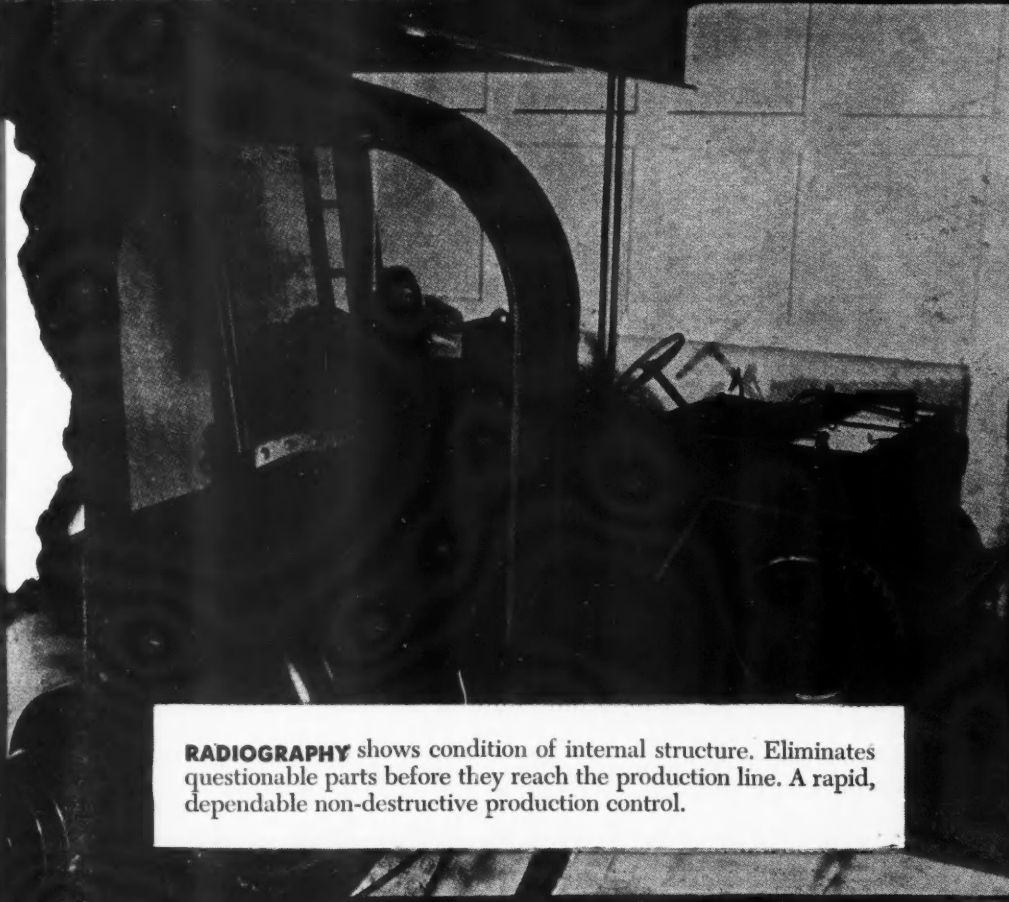



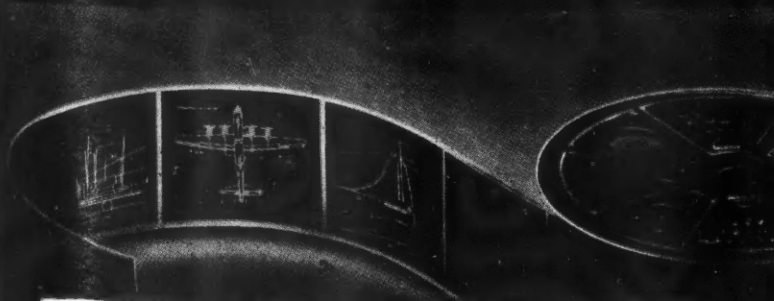
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RADIOGRAPHY shows condition of internal structure. Eliminates questionable parts before they reach the production line. A rapid, dependable non-destructive production control.



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Kodak

New Products

Electronic Device Counts and Records Work Pieces

An electronic device that counts parts produced on any motor-driven machine and makes an accurate, tamper proof record has been developed by the Lansing Engineering Co., Lansing, Mich. This new device, the Lansing

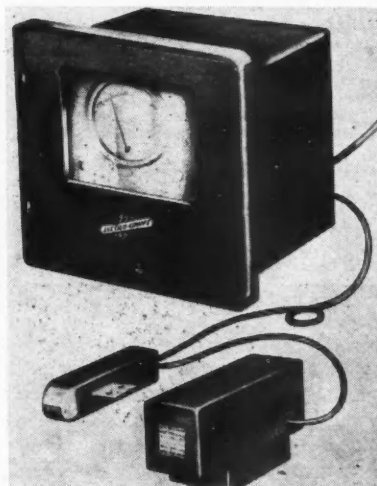
Lectro-Count, records total number of pieces, time required to make each piece, machine down time, and number of pieces per minute, per hour or per day, all by remote electronic control.

The Lectro-Count is actuated by the difference in current consumed by the electric motor when the machine is idling, and the current consumed by

the motor when the machine is doing useful work.

The primary of a current transformer is connected in series with the motor driving the machine. The secondary of the transformer is connected to the Lectro-Count.

The Lectro-Count takes advantage of the maximum current consumed by the motor in driving a machine and also



Lansing Lectro-Count

the time this current will be consumed to count and record the number of parts or pieces produced. With a calibrated dial and switch the Lectro-Count system can be adjusted to adapt itself to the various machining, forming, or drilling operations.

Hydraulic Pump for Wide Variety of Applications

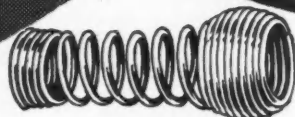
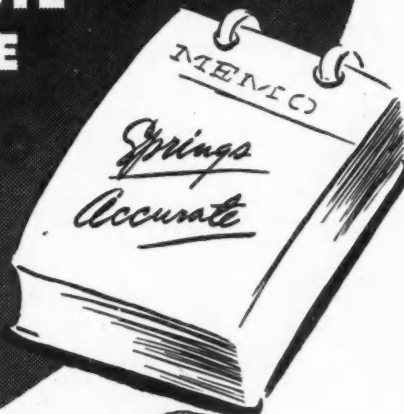
A line of light, compact hydraulic pumps capable of producing up to 5000 psi and delivering from 0 to 17 gpm at 1200 rpm is offered in constant or variable delivery types by Hydraulic Machinery, Inc., and Superdraulic Corp., Dearborn, Mich. Embodying many interesting principles of design, the Superdraulic pump is intended for a variety of applications including—full hydraulic drives for motor vehicles and industrial engines; for installation in hydraulic presses and cylinder-actuated machinery; for use in hydraulic production test equipment and for experimental test devices; for other machinery using hydraulic power.

The pump is of radial plunger type arranged so that centrifugal force maintains the plunger rollers in contact with an elliptical reaction ring. The plungers are fitted to cylinders in a rotor in one or more banks of 11 plungers per bank. The rotor turns on a fixed pintle which has suitable ducts and ports for directing the oil inlet into those cylinders passing through two opposite quadrants and also for directing the oil delivery out of those

(Turn to page 74, please)

GOOD PRODUCTS DESERVE GOOD SPRINGS

**DON'T WASTE
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YOU have more time for more things when you put your spring problems in our lap. Many of our customers do this: They let our engineers design the springs best suited to their particular jobs . . . they tell us when they need them . . . and how many. And that's all there's to it. Q They've learned from experience that the springs will be delivered on time . . . that they will be *right* . . . and that the price will be fair. Q That's our service policy: to make your spring buying as easy as possible. Try us.

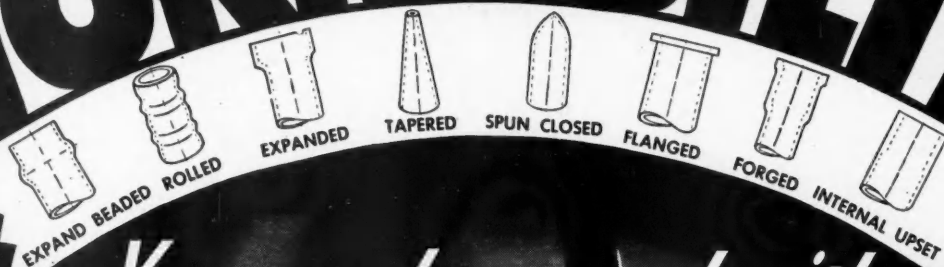
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WIRE FORMS
STAMPINGS



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your spring
problems
with you

ACCURATE SPRING MANUFACTURING CO., 3811 W. LAKE ST., CHICAGO 24, ILL.

WORKABILITY



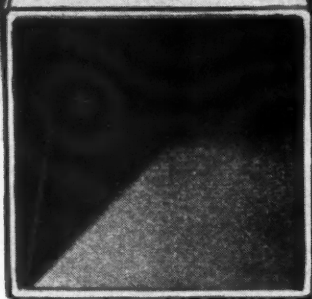
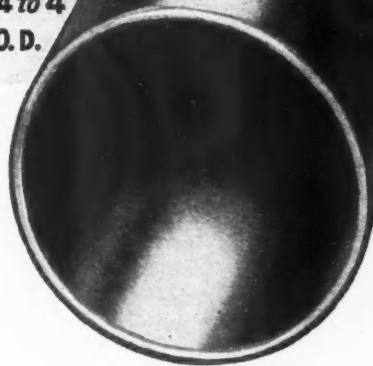
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**ROUND • SQUARE • RECTANGULAR
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Michigan welded steel tube can be flanged, expanded, cold drawn, fluted, flattened, bent, coiled, upset, beaded, grooved, rolled, spun, threaded, tapered, and shaped to

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Engineering advice and technical help in the selection of tubing best suited to meet your needs.

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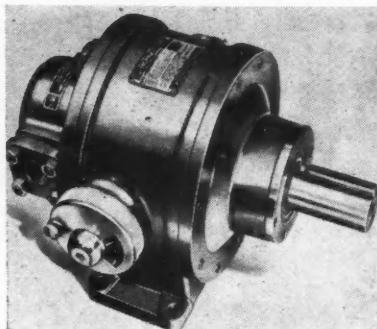
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cylinders passing through the other two opposite quadrants.

Each plunger makes two inlet and two delivery strokes per revolution. An equalizing axle, journaling a roller at each end, is universally attached to the outer end of each plunger.

In variable delivery pumps, two banks of 11 plungers each are arranged in a single rotor. Each pair of parallel cylinders is in open communication by means of a drilled passage in the rotor. The plunger rollers, of each bank, roll against a separate elliptical reaction ring. These reaction rings are rotatably mounted in the pump housing and are



Superdraulic pump

geared together so that they rotate in opposite directions in response to rotation of the volume control gear. At full delivery, the major axes of the elliptical reaction rings are parallel while at zero delivery they are 90 deg apart.

Variable delivery pumps are equipped with any one of a number of different type volume controls, interchangeably mounted on the pump. The sensitive manual dial type control may be mounted on either side of the pump. The surge-proof balance pressure compensator can be mounted on either side of the pump with a volume dial indicator mounted on the side opposite.

A small oil circulating pump is incorporated to circulate oil under near zero pressure direct from the oil tank through the pump housing and back to the tank. This insures sufficiently low pump housing temperatures of the variable delivery pump under the condition of extreme pressure operation at zero or near zero delivery.

Gasoline-Burning Heater for Cars, Trucks and Buses

Stewart-Warner Corporation's heater division has announced its first post-war automotive heater development, the "South Wind Deluxe Heater," for passenger cars, trucks or buses.

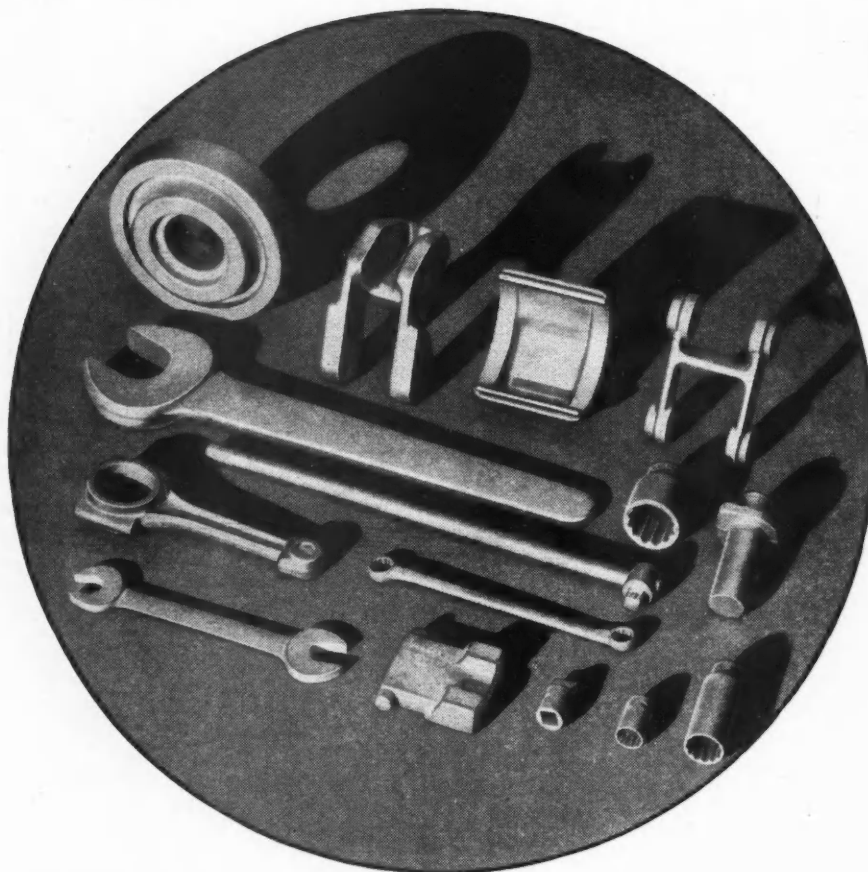
The new heater is said to provide quick heat output and exclusive air-conditioning and humidity control features not previously available in mobile

(Turn to page 76, please)

Clark Truckloader



This compact, light weight fork truck, the "Truckloader," designed to lift, carry, stack and tier unit package loads up to 1000 lb. has been introduced by the Truck-tractor Division of Clark Equipment Co., Battle Creek, Mich. The Truckloader is said to be specially adapted for fast loading and unloading of highway trucks and trailers. It is maneuverable in narrow aisles and has an exceptionally small turning radius of 57 in. With its light weight it will run safely in and out of trucks and trailers, and can be used in elevators which can not handle heavier units.



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February 15, 1946

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For Hardening Small Parts

**175 to 2000 lbs. per hour
Uniformly — Scale-Free — Continuously**

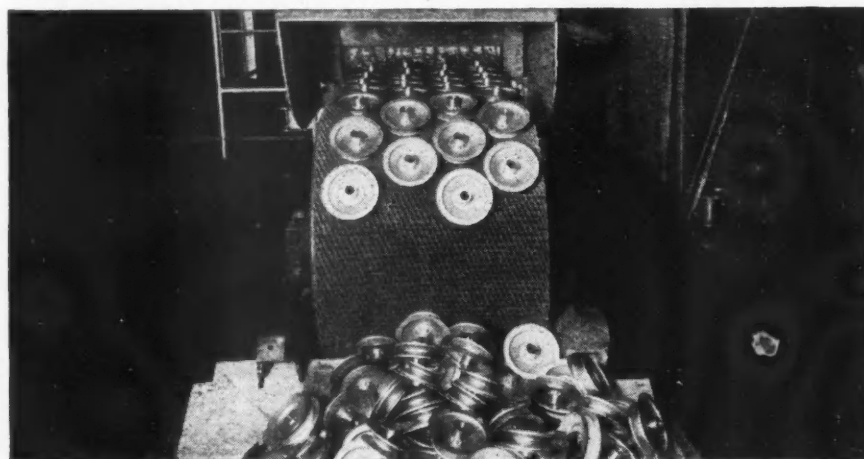
The above gas fired radiant tube chain belt furnace is one of three we installed in one plant. Hundreds are in operation handling products such as listed at left. We build them for gas, oil or electrically heated.

The EF chain belt conveyor type furnace is one of the most satisfactory general purpose furnaces built for the continuous, uniform, economical production heat treatment of small and medium size products. We will be glad to send complete data on these and other types we build.

Send for circulars showing the chain belt and other types of EF production furnaces

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Gas Fired, Oil Fired and Electric Furnaces—For Any Process, Product or Production



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heating equipment. Among these features are rapid heating, introduction of a large volume of warmed, fresh air; draftless distribution of heat through ducts to concealed outlets in passenger or cargo space, and, a modulating flow temperature control device which "anticipates" temperature changes and adjusts the heater operation to maintain pre-selected temperature in the vehicle.

The South Wind Deluxe heater is a gasoline-burning heater with maximum heat output of 20,000 Btu per hour. Mounted under the car hood and equipped with a blower which draws in cold, fresh air from a point just behind the radiator grill, the heater warms and delivers to the ducting system sufficient air to provide a complete air change



South Wind De Luxe heater

within the passenger space of the automobile every 90 seconds or less.

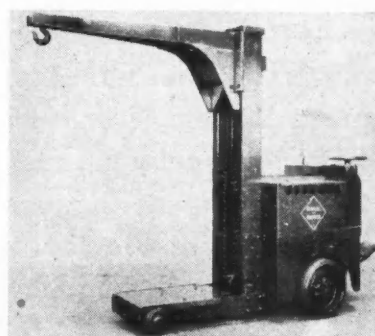
The heater has no effect on engine performance. The fuel supply is taken from the gasoline line between the fuel pump and the carburetor, in normal installation. There is no connection to the manifold or to the engine cooling system.

Power Truck with Non-Swivel Type Boom

A power truck equipped with a horizontal, non-swivel type boom, moving vertically with its shoulder riding in the upright columns of the truck, has been brought out by the Elwell-Parker Electric Co., Cleveland, Ohio. The boom functions somewhat as a boom on a crane, but the complete unit is more compact and can be maneuvered within more limited areas.

This mechanism is said to be particularly useful for single, heavy and bulky objects to which a hook, chain, rope or cable may be attached. No muscle-power is required beyond se-

(Turn to page 80, please)



Elwell-Parker truck

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Gaylord Container Corporation
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OTHER INDUSTRIES

American Tobacco Co.
Canada Dry Ginger Ale, Incorporated
Carrier Corporation
The Detroit Edison Company
Endicott Johnson Corporation
The Globe-Wernicke Co.
Long Bell Lumber Co.
P. Lorillard Co.
Pullman Standard Car Mfg. Co.
Spiegel, Inc.
Underwood-Elliott-Fisher Co.

CUT HANDLING COSTS IN HALF!

FRONT WHEEL POWER DRIVE

This feature permits the Transporter "to turn on a dime." It gives complete freedom in maneuvering sharp corners and making turns in narrow aisles. It will turn a full 210 degrees with constant power. All Transporters have this Front Wheel Power Drive. Back Wheel Power Drive Trucks can't begin to provide such time and energy-saving "turnability."

LOWEST OPERATING COST

The Transporter is the only material handling electric truck that provides maximum power for a full day's hauling and yet uses only an ordinary light socket for 8 hour recharging. Current cost is 10c to 11c a day based on an electric current cost of 2c a kilowatt hour. Again, no other electric truck can approach such economy in battery, charger and current cost.



Transporter

A PRODUCT OF AUTOMATIC

Lightens
LIFE'S LOADS

AUTOMATIC TRANSPORTATION CO.
Div. of the Yale & Towne Mfg. Co.,
57 West 87th Street, Dept. B, Chicago 20, Ill.

Please send me complete information about Transporter, the miracle electric truck, and how it can cut my material handling costs in half.

Company Name.....

By.....Position.....

Street Address.....

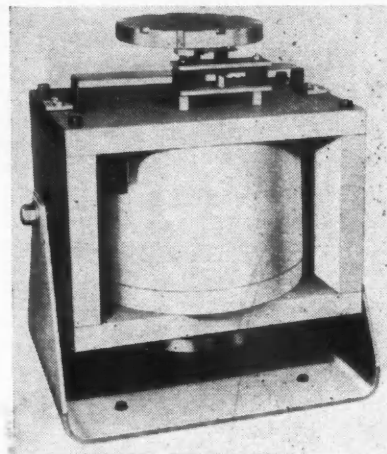
City.....State.....

curing a chain or cable to the object and to the hook on the boom. Suspended by a short length of chain, an object can be swung around easily for passage through narrow aisles or doors, or for positioning for finishing operations, or shipping.

The truck can carry loads up to 3000 lb. The boom is available in lengths of 72, 66 and 60 in. from face of uprights. At lowest point the hook is 22 in. above floor level; at highest, 8 ft. The boom may be made interchangeable with a platform whereby a still greater variety of loads may be transported.

Electrodynamic Vibration Exciter and Calibrator

An electrodynamic exciter-calibrator, designed to deliver a peak force of 200 lb over a wide frequency range, has been added to the line of the MB Manufacturing Co., New Haven, Conn. It enables the test operator to excite a product or part to its resonant modes of vibration with a pure sine wave force that can be controlled in both frequency and amplitude. It provides a means for studying the nature of these modes, and the most practical type of correction.



MB exciter-calibrator

This equipment has the power to vibrate mechanical structures and parts to destruction—pointing out weak spots by these failures. It helps in locating noise sources, in addition to duplicating age-loosening of parts that would normally be achieved in several months of operational tests.

When operating the machine above its own mechanical resonance, vibration pickups (acceleration, velocity and displacement types) can be calibrated with a wave form as good as that of the current source. Rated accelerations as high as 20 g. are produced, with a peak of 40 g. obtainable for short periods. Maximum table travel is 1.0 in. A standard signal generator attached to the shake table will allow a check of the amplitude in comparison to the pickup being calibrated. The table is adjustable for motion in any direction.

Total weight of this Vibration Exciter is 685 lb. A motor-generator-alternator power supply is available for use with this equipment.

Non-Corrosive Rust Remover

The Nox-Rust Chemical Corp., Chicago, Ill., has placed on the market a rust remover that is said to wet metal thoroughly, dissolve rust scale rapidly, remove it completely, and be relatively non-corrosive to steel even under conditions of long exposure.

This new rust remover can be applied by usual methods such as brush, spray, and dip, but its long life and rapid action in otherwise inaccessible crevices make dipping the most economic wherever practical. Other uses include rust removal from castings, steel stock, fabricated parts, hand tools, periodically idle farm and process equipment, and government surplus items exposed to weathering during storage.

Diamond Files and Hones for Dressing Carbide Tools

The Wendt-Sonis Co. of Hannibal, Mo., offers a new line of Diamond "R" files and hones, for dressing carbide (Turn to page 82, please)

Johnson



TAPPETS

Hy-draulic, self locking adjustable, and conventional adjustable tappets for automotive, diesel, and aircraft engines.

LET JOHNSON HELP YOU SOLVE YOUR TAPPET PROBLEMS

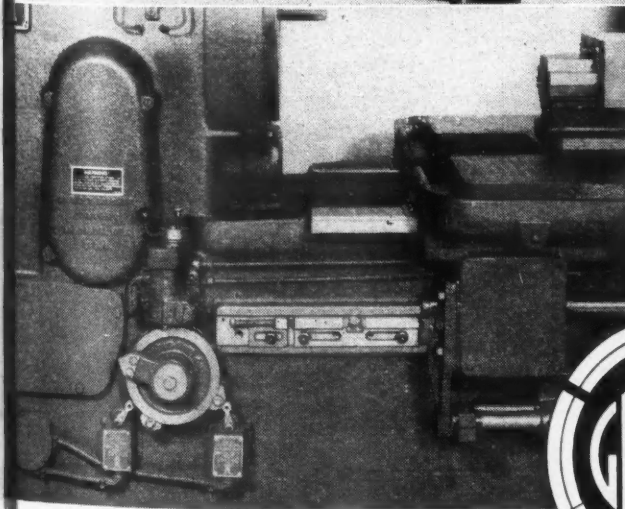
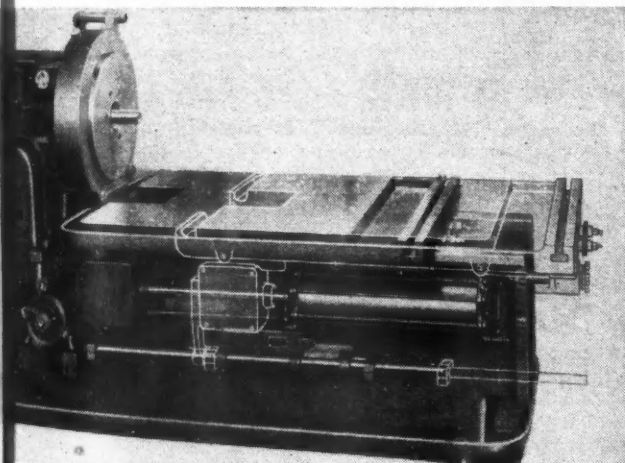
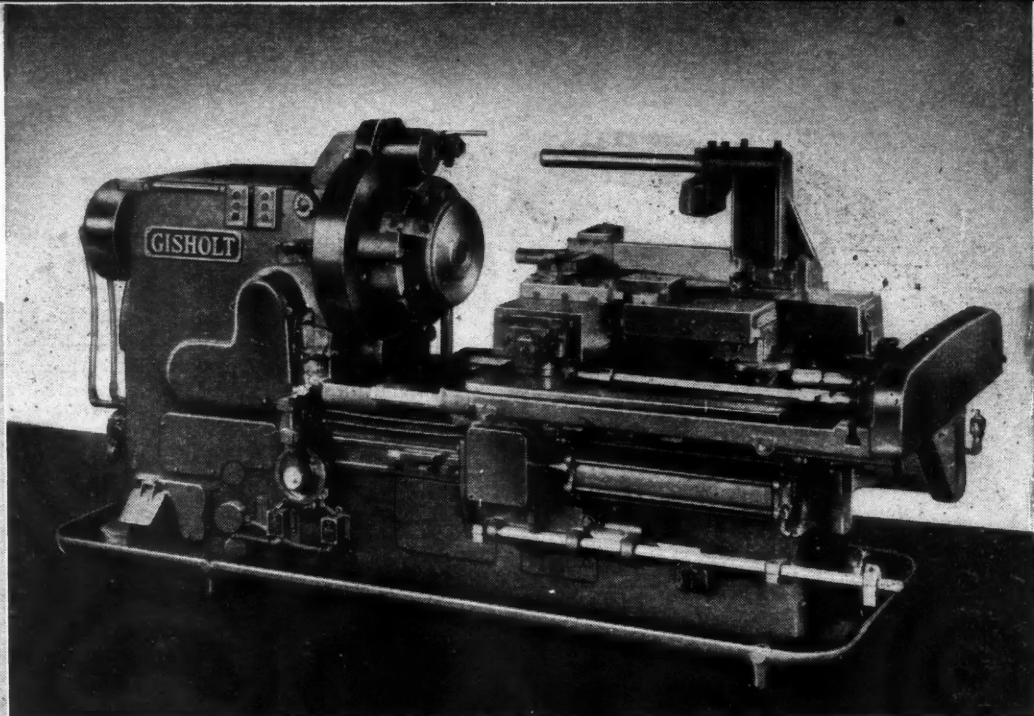
JOHNSON PRODUCTS, INC.

MUSKEGON HEIGHTS, MICHIGAN

The

GISHOLT SIMPLIMATIC

Simple - and Fast, too!



ON CHUCKING, FOR EXAMPLE—

Easy access to the chuck or fixture for quick removal and loading of work is made possible by the fast, automatic retraction (traverse) of the platen table from the working position—done by pneumatic cylinders on each side of the machine bed.

AND TOP SPEEDS AND FEEDS CAN BE USED—

While in working position, the table is locked to the bed by a mechanical dog, pressed into the plate catch shown at lower left. It is further positioned and held by double adjustable nuts on a stop rod on the back of the bed; pressure is maintained in the traverse air cylinders while cutting is under way.

A rock-solid base for working tools is provided by the platen table resting on hardened and ground steel ways and gibs. With the smallest standard size platen table weighing almost a ton, you have the rigidity to take whatever speeds and feeds the cutting tools can withstand.

Ask for your copy of the new Simplimatic Catalog.

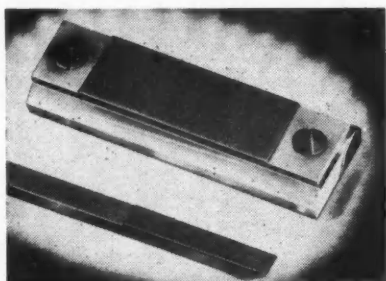


GISHOLT MACHINE COMPANY

1205 E. Washington Ave. • Madison 3, Wis.

*Look Ahead . . . Keep Ahead . . . with
Gisholt Improvements in Metal Turning*

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES



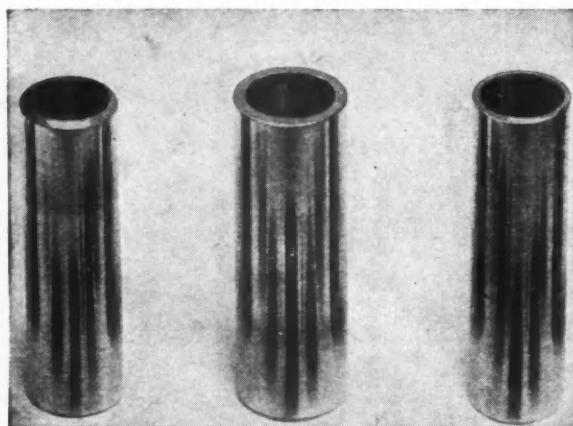
Diamond "R" hone and file

cutting tools without removing them from the machine.

The files and hones contain a 100 concentration of diamonds in a new

and exclusive metal bond. This bond is said to enable both to maintain a flat surface throughout their service life. As a result, the tools sharpened do not become grooved. This Wendt-Sonis bonding process also allows these diamond impregnated files and hones to be used on high speed steels without loosening the diamond particles.

The file shanks are made of drill rod stock. Each comes in a leather case. The hone is mounted on a Lucite base.

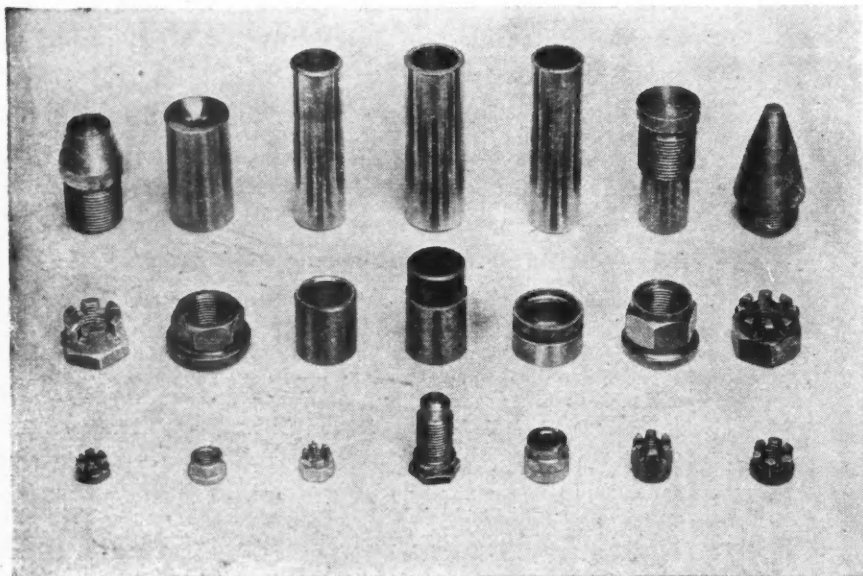


These are samples of precision parts (illustrated below) of ferrous and non-ferrous alloys that have been made by Bessemore. On each of them, the screw machine work was completed within ten and twenty-five seconds and .002" tolerances were maintained. The grinding work is held to .0001" (tenth).

PISTON PINS . . . Surface finish one to two micro inches . . . for passenger cars—trucks—tractors—marine and aircraft engines—gasoline and diesel type to your specifications.

BESSEMORE specializes in precision screw machine manufacture . . . making more of them better. Our engineers will be glad to make recommendations without obligation . . . send us your blueprints.

BESSEMORE PRODUCTS CO.
13243 East Warren Avenue
Detroit 13, Michigan



New Ideal Pneumatic Riveting Hammers

A new line of pneumatic riveting hammers featuring small size and light weight is now in production at the Ideal Commutator Dresser Co., Sycamore, Ill. Other features include hand-fitting grip design, controllable speed and improved balance.

The barrel is of one piece, all steel



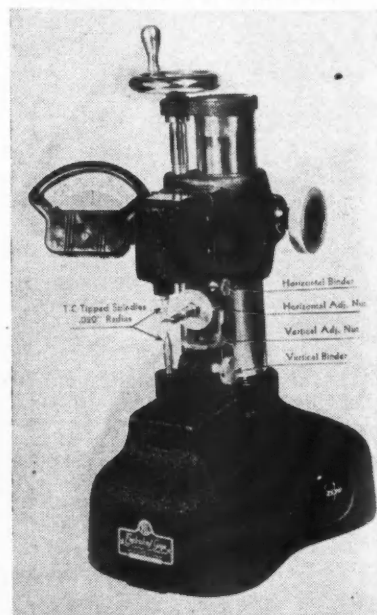
Air-Horse pneumatic riveting hammer

construction with a reinforced end to take piston impact without breaking. The piston is made of hardened alloy steel. The valve block and sleeve valve are made with large wearing surfaces.

An air throttling regulator valve, included with the hammer, permits fine adjustment to accommodate all kinds of riveting. When used with the proper tool, the Ideal "Air-Horse" is also suitable for caulking, scaling, chipping and other work.

External Comparator with Ball Gaging Spindle

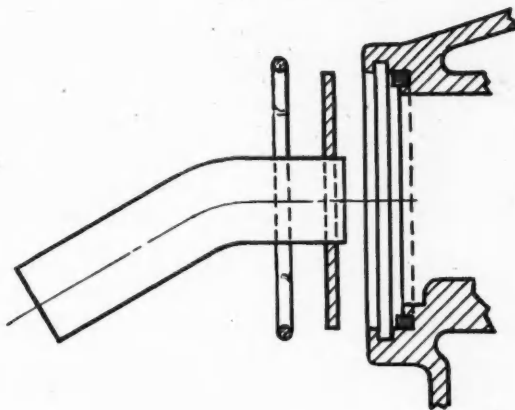
Pratt & Whitney, Division Niles-Bement-Pond Co., West Hartford,
(Turn to page 84, please)



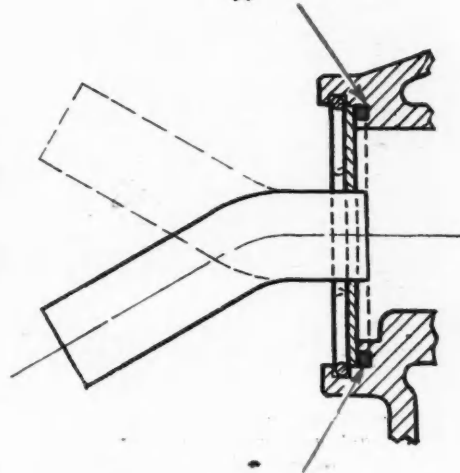
Model CE-699 Electrolimit comparator

TRULY COMPRESSIBLE GASKET

1. Permits snap ring assembly



2. Allows sealed part to be positioned after assembly



One of Armstrong's truly compressible cork-and-synthetic-rubber compositions is solving both an assembly and an installation problem for the manufacturer of a well-known vacuum unit.

Since the tube and cover assembly for this unit is held in place by a snap ring, the gasket must be sufficiently compressible to permit the retainer to be snapped into place. And installation conditions demand that the cover and tube assembly be free to rotate into proper position without impairing the seal.

Straight synthetic rubber compounds were unsuccessful because they were not compressible. Cork composition was tested, but it was too low in tensile strength. However, rings die-cut from Armstrong's DC-152 cork-and-synthetic-rubber composition, treated with oil and graphite, solved both problems.

Armstrong's DC-152 compresses to allow easy assembly, yet it is impermeable and maintains a perfect seal under all weather conditions. The oil and graphite treatment reduces friction and permits the tube to be positioned for proper installation. Vacuum is maintained; dirt and moisture are positively sealed out.

Whatever your gasket problem may be, you will get the right answer faster when you consult an Armstrong Gasket Engineer. His recommendations are based on Armstrong's 34 years of gasketing experience. And he has a wide range of stock resilient materials at his command. These include synthetic rubber compounds, cork-and-synthetic-rubber compositions, fiber sheet packings, and rag felt papers.

For helpful, unbiased recommendations, send working drawings and details of your application to us today. There's no obligation, of course.



SEND FOR FREE BOOKLET

For descriptions of Armstrong's Sealing Materials, see Sweet's File for Product Designers. Or write us for your copy of the free booklet, "Gaskets, Packings, and Seals." Address Armstrong Cork Company, Gaskets and Packings Department, 1502 Arch St., Lancaster, Penna.

ARMSTRONG'S GASKETS • SEALS • PACKINGS

Cork Compositions • Cork-and-Synthetic-Rubber Compositions
Synthetic Rubber Compounds • Cork-and-Rubber Compositions
Fiber Sheet Packings • Rag Felt Papers • Natural Cork

Conn., has designed the Model CE-699 Electrolimit external comparator for checking balls. This comparator is equipped with a special gaging spindle, anvil and backstop, making it ideally suited for the inspection of balls.

The gaging spindle and anvil are identical pieces having a T-C gaging tip with .020-in. radius. The backstop is a T-C Vee located in the anvil fixture with provision for both vertical and horizontal adjustment.

The indicating meter can be graduated in "tenths," "half-tenths" or "hundredths," to meet any inspections requirement.

Feather Ride Suspension

A unique system of vehicle suspension for installation on tandem axle trailers for heavy duty service—a coil spring suspension having many interesting features is a recent development of Feather Ride Inc., Portland, Ore. Listed among its principal advantages are the following claims: the use of underload springs, self-contained coil spring units with built-in frequency snubbers, reduction in dead weight, elimination of axle kick-up on fast braking stops, simplification of parts and interchangeability of the parts, elimination of chassis lubrication

points, automatic steering that reduces tire scuffing, a load indicator, and clean appearance.

As illustrated, the spring element consists of a completely enclosed housing containing two sets of nested coil springs, so arranged that when the vehicle is empty or lightly loaded, the suspension is carried on the small and more flexible underload springs. For heavy loads the suspension rides on the heavy main springs. Stability, by virtue of small deflection, is achieved by limiting the deflection of the main springs to a maximum of two in.

The spring housing also contains the Feather Ride Control, a simple mechanical snubber which may be seen installed between the springs. Its action depends upon the movement of three metal shoes which slide up and down within a tapered cylinder. Upon im-



- Buell Air Horns are tops in warning signal efficiency.
- Installed as original equipment on many Trucks and Buses.
- They reduce maintenance costs by decreasing stops, starts and slow-downs.
- All records prove that they save tires, brakes, clutches and gears.
- Cut gas and oil consumption.



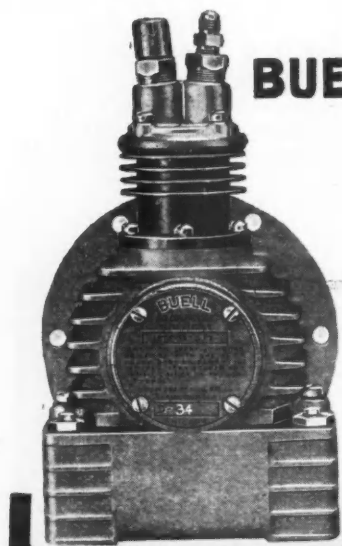
A Buell Air Horn is worth \$100.00 yearly on any heavy highway vehicle. With a Buell the driver has greater security, maintaining a steady cruising speed. Slowing a 20 ton load from 50 MPH to 30 MPH means destroying a lot of energy thru brake lining and tires. It is replaced by burning more gasoline, increasing load on engine, and tires again, to regain speed. This all costs money. We believe \$100.00 yearly is a low estimate. Then remember a Buell will last more than 10 years. How would you rate a \$100.00 investment that earned \$100.00 yearly for 10 years. Ask the man who has a Buell.

BUELL AIR COMPRESSOR

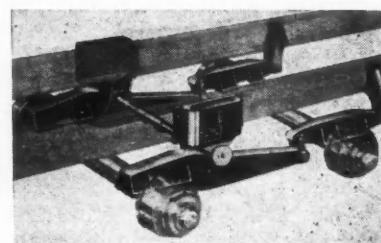
- Used on Passenger Cars, Trucks, Buses, Boats and Planes.
- Small and compact in size . . . efficient and powerful in action.

Buell engine-driven compressors supplied air to operate air-brakes in thousands of R.C.A.F. aircraft. Only a combination of quality and precision workmanship could meet the requirements of this type of service.

Designed for compactness and light weight, they are far more efficient and powerful than their size indicates. Let us prove their adaptability to your needs.



BUELL MANUFACTURING CO.
2975 COTTAGE GROVE AVE., CHICAGO 16, ILL.



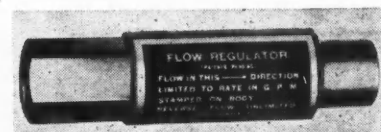
Feather Ride tandem axle suspension

pact the shoes are expanded against the cylinder by a wedge. They return to normal position by the action of the coil suspension springs. Cylinder and shoes are self-lubricating and require no attention.

The suspension is attached at two points to the frame—directly ahead of the front axle and ahead of the rear axle, which is the location of the spring housing. The design of the leverages is such that 25 per cent of the load is carried by the front bracket and 75 per cent by the rear bracket. This reduces the loading on the spring member to 75 per cent of the actual load. The springs at the rear provide a cushion between the frame and axles at both

(Turn to page 88, please)

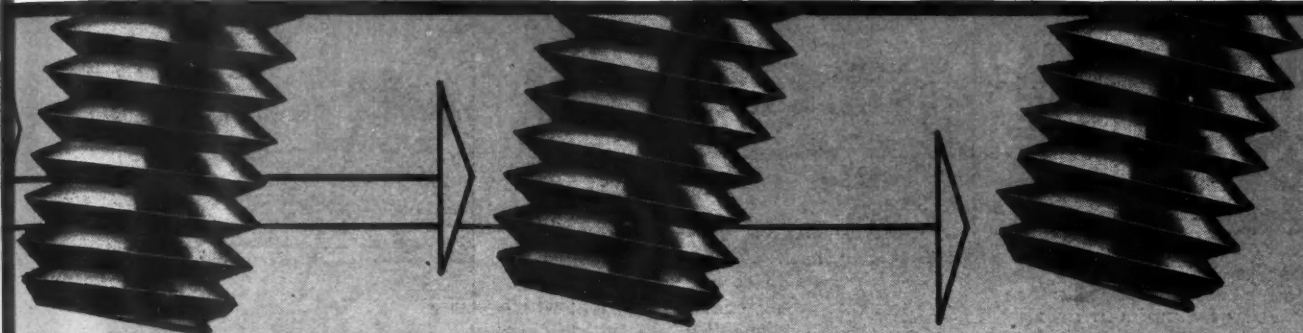
Automatic Flow Regulator for Hydraulic Systems



The waterman Engineering Co., Chicago, has originated this automatic flow regulator for hydraulic systems where unlimited flow in one direction is required, with a pre-determined rate of flow in the other direction. The Waterman hydraulic flow regulator occupies a space only a fraction larger than the line in which it is used



PRE-ASSEMBLED TO REDUCE YOUR COSTS!



**THE USE OF *SEMS* ELIMINATES TIME-WASTING
HAND ASSEMBLY OF WASHERS AND SCREWS . . .
ONLY ONE UNIT TO HANDLE . . . FASTER, EASIER
TO DRIVE . . . ASSURES BETTER FASTENINGS AND
IMPROVED PRODUCT PERFORMANCE.**

***SEMS* ARE AVAILABLE FROM THE FOLLOWING FASTENING MANUFACTURERS:**

American Screw Co. Providence, R. I.	The Lamson & Sessions Co. Cleveland, O.	Progressive Manufacturing Co. Torrington, Conn.
Central Screw Co. Chicago, Ill.	Manufacturers Screw Products Chicago, Ill.	Russell, Burdall & Ward Bolt & Nut Co. Port Chester, N. Y.
Chandler Products Corp. Cleveland, O.	National Lock Co. Rockford, Ill.	Scovill Manufacturing Co. Waterbury, Conn.
Continental Screw Co. New Bedford, Mass.	The National Screw & Mfg. Co. Cleveland, O.	Shakeproof Inc. Chicago, Ill.
The Corbin Screw Corp. New Britain, Conn.	New England Screw Co. Keene, N. H.	Steel Co., of Canada, Ltd. Hamilton, Ont., Canada
Eaton Mfg. Co. Reliance Spring Washer Div. Massillon, O.	Pheoll Manufacturing Co. Chicago, Ill.	

Safe Oakite Cleaning Compounds

are
specially designed to

CONDITION ALUMINUM SURFACES

If your present or future production plans include surface treatment of aluminum or aluminum alloys careful consideration should be given to selection of cleaning materials and methods to assure high quality production at greatest possible speed.

Oakite calls your attention to their comprehensive collection of cleaning compounds deliberately designed for the safe cleaning of aluminum surfaces. These Oakite surface conditioning materials have been scientifically engineered to meet such essential requirements as type and amount of foreign matter to be removed; degree of cleanliness (chemical or physical depending on subsequent surface finish); type of metal cleaning equipment, and other factors of vital importance.

FREE SERVICE . . . FREE DATA

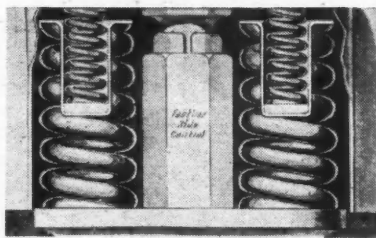
Oakite offers you the free personal cooperation of a competent Technical Service Engineer. His extensive experience on the cleaning and conditioning of metals can be put to practical use in solving your particular production problems. Technical literature covering industrial cleaning in all its phases gladly mailed free on request. Remember to call Oakite!

OAKITE PRODUCTS, INC.
28A Thames Street, New York 6, N. Y.
Technical Service Representatives Located in All
Principal Cities of the United States and Canada

OAKITE *Specialized*
CLEANING
MATERIALS • METHODS • SERVICE

points since the trunnion is arranged to float and carries no load. The load imposed on the frame is distributed equally between the two axles.

The suspension is said to provide "automatic" steering by allowing the axles to shift not only sideways under the frame but to conform to the curve of the road as well. This is claimed to result from the fact that the entire assembly is mounted in rubber and has sufficient flexibility to permit the axles



Cutaway view of springs and control of Feather Ride suspension

to conform to a position of least resistance in negotiating a turn. In addition, both axles are "pulled" in contrast to conventional hook-ups in which one axle is "pulled" while the other is "pushed."

Considerable weight saving is claimed, the actual saving depending upon the weight and size of the existing suspension system. The load indicator which is a part of the spring housing enables the operator to gage the load and thus prevent overloading.

Ground Thread Set-Screws

A line of ground-thread set screws is now offered to the trade by Parker-Kalon Corp., New York, N. Y. The threads are ground on hardened stock, eliminating the need for subsequent heat-treatment and possible distortion. Instead of black, the new set screws have the distinctive bright appearance, and characteristic smoothness and accuracy, of a ground finish.

Motor Wheel Corp. to Buy Airplane Propeller Plant

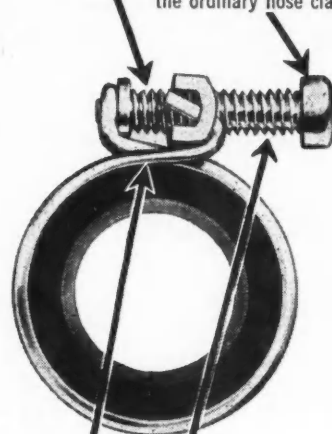
Formerly operated by the Nash-Kelvinator Corp., the Mt. Hope Avenue airplane propeller plant in Lansing, Mich., will be sold to the Motor Wheel Corp. of Lansing for \$1,137,526.54, subject to the priority right of governmental agencies, according to the War Assets Corporation, a subsidiary of Reconstruction Finance Corporation. The buyer will convert the Lansing project to the production of gas and oil heaters and furnaces.

The new production line will require plant alterations and changes costing \$400,000 and will give jobs to 1200 workers, it is stated by the Motor Wheel Corp.

5 STAR FEATURES of the NEW Central "360" HOSE CLAMP!

PUSH+PULL POWER! LOOK how the new, perfect mechanical principle of push plus pull clinches this clamp's powerful wire strands into a vise-like grip on the hose.

RUGGED STRENGTH! SEE how every part of the "360" is "oversize" for extra strength. For instance—compare the driving power of powerful screw with that found on the ordinary hose clamp.



NO BLIND SPOT! THE ABSENCE of a "tongue," found in all other clamps, completely eliminates the "blind," or "soft" spot—the primary cause of leakage in other clamps.

A PERFECT CIRCLE! DON'T OVERLOOK how, because of the new push plus pull principle, terrific pressure is exerted on every point, without damage to the hose. This 360 degree grip is positive leakage prevention.

UNUSUAL TAKEUP! COMPARE the exceptional takeup of the "360" with that of the ordinary clamp. This more than sufficient takeup guarantees elimination of leakage trouble, even on today's irregular synthetic hose.

Write today for your FREE
sample of Central's "360" Wire Hose
Clamp and Bulletin Number 2246.

CENTRAL EQUIPMENT CO.
900 S. Wabash Ave., Chicago 6, Ill.

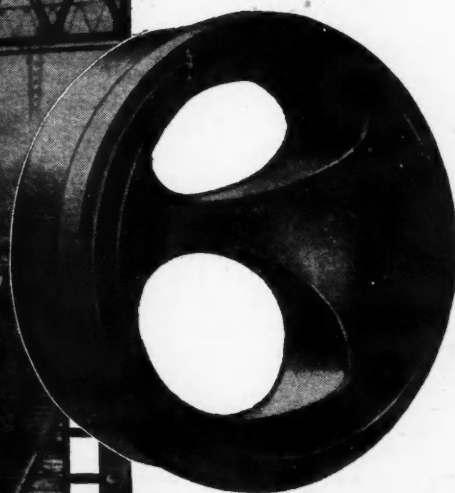
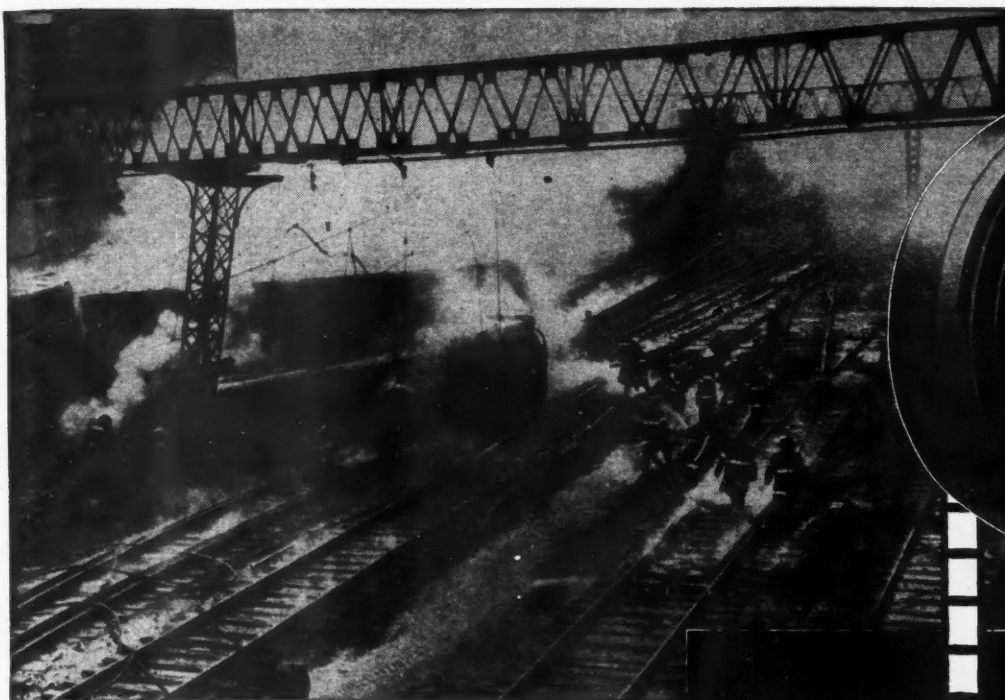


Photo courtesy Rockwood Sprinkler Corp.
HYCAR part by Graton & Knight Co.

The fire that got lost in a fog

TEN thousand blazing gallons of gasoline from a wrecked tank car brought under control in 14 minutes; completely extinguished in 40—thanks to a "Waterfog" hose nozzle that blankets the fire in man-made fog. Thanks are due, too, to the nozzle's valve seat, made from HYCAR.

The valve seat controls the flow of water to the nozzle, and any failure there means failure of the entire unit. The requirements are severe—not individually, but because a material to meet these requirements has to have certain properties in exactly the right combination.

High tensile strength and low compression set to prevent distortion of the HYCAR seat . . . abrasion resistance to withstand the rushing water at 150 psi pressure : : : permanent resilience to

maintain a *positive* seal . . . non-adherence to metal to permit free operation of all the valve parts.

Valve seats made from HYCAR having these properties in the right combination show again why parts made from HYCAR have an important place in all industry—as gaskets and seals of all kinds, hose, diaphragms, vibration dampeners, and hundreds of other applications where long life and dependability are the truly basic requirements. Examine the list of properties in the box at the right. Apply them to your own resilient parts. Then *ask your supplier* for parts made from Hycar for long-time, dependable performance. HYCAR synthetic rubber is manufactured by B. F. Goodrich Chemical Company, Dept. HH-2, Rose Building, Cleveland 15, Ohio.

CHECK THESE SUPERIOR FEATURES OF HYCAR

1. **EXTREME OIL RESISTANCE**—insuring dimensional stability of parts.
2. **HIGH TEMPERATURE RESISTANCE**—up to 250° F. dry heat; up to 300° F. hot oil.
3. **ABRASION RESISTANCE**—50% greater than natural rubber.
4. **MINIMUM COLD FLOW**—even at elevated temperatures.
5. **LOW TEMPERATURE FLEXIBILITY**—down to -65° F.
6. **LIGHT WEIGHT**—15% to 25% lighter than many other synthetic rubbers.
7. **AGE RESISTANCE**—exceptionally resistant to checking or cracking from oxidation.
8. **HARDNESS RANGE**—compounds can be varied from extremely soft to bone hard.
9. **NON-ADHERENT TO METAL**—compounds will not adhere to metals even after prolonged contact under pressure. (Metal adhesions can be readily obtained when desired.)

Hycar

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LARGEST PRIVATELY PRODUCED BUTADIENE TYPE

Synthetic Rubber

B. F. Goodrich Chemical Company

A DIVISION OF
THE B. F. GOODRICH COMPANY

February 15, 1946

When writing to advertisers please mention AUTOMOTIVE and AVIATION INDUSTRIES

89

Aircraft Firms Diversify

(Continued from page 18)

this humane work is one of the most radical departures from building such deadly warplanes as the P-61 Black Widow that could be imagined.

The Glenn L. Martin Co., Baltimore, has developed numerous new products of a non-aeronautical nature. Its Plastic and Chemicals Division, formed in 1944, has expanded until construction is now under way on a \$1,500,000 plant for the manufacture of 11,000,000 lb of marvinol polyvinyl resins annually. Among the products for which this new

elastic plastic will find use are multi-colored wire, transparent garden hose, wrist watch straps, woven fabrics, handbags, surgeon's and industrial gloves, etc. Another development of the firm is a special process by which photographs may be printed on wall paper in the home. The developer is washed onto the living room wall paper, an enlarged exposure made, developed and "fixed," providing an attractive household decoration. The well-known Mareng cell has already found wide

use as boxcar interliners for the storage of gasoline or other fuels and lubricants. After delivery of the cargo, the cell may be folded into a compact bundle for return shipment.

The Martin company and the United States Plywood Corp. have developed a lightweight construction material which is claimed to be structurally stronger than anything of the same weight now being manufactured. It consists of a honeycomb core of plastic-impregnated cloth or paper sandwiched between and firmly bonded to thin sheets of aluminum, stainless steel, wood veneer, or plastic.

An interesting development in the aircraft manufacturing field is the creation of airplane servicing departments by established manufacturers. Martin has announced plans to provide complete repair, spare parts, overhaul and servicing facilities at its plant for airline and privately-owned airplanes. Lockheed Aircraft has established a similar service at its home field in Burbank. In addition, Lockheed has formed Airquipment Co. for the design, manufacture and merchandising of ground handling and aircraft servicing equipment. This will include cranes, tow-trucks, jacks, ladders and stands, etc. Since then Lockheed purchased the total capital stock of the Pacific Engineering Corp., producers of aircraft ground handling equipment, and merged this company with Airquipment.

Solar Aircraft Co., San Diego, has started to build aluminum-steel bodies for midget racers. Recently Solar acquired the Fonda Machinery Co., Inc., of Los Angeles, manufacturers of developing machines for the photographic industry, which will be operated as the Fonda Film Processing Division of Solar. Another subsidiary organized by Solar is the Hubbard Casket Co., which is in production on stainless steel caskets.

But perhaps the fastest-moving firm of them all is Menasco Manufacturing Co., Los Angeles, for 20 years designers and builders of air-cooled in-line engines. Between V-J Day and Christmas, 1945, Menasco designed, produced, merchandised and sold more than 200,000 "fireless" cooking utensils!

Observers in the industry feel, however, that this divergent activity of the aircraft industry may be, in most cases, a temporary "stop gap" operation designed to take full advantage of a tremendous market and to tide over firms particularly hard-hit by V-J Day until their well-known aircraft and engine designs for the postwar market can be fully developed and produced. While it is evident that the many new products of these aircraft firms will continue in quantity production and development for the consumer field, the rapidly developing aircraft market, both here and abroad, should reach its flood within the next three years and the "aircraft" industry may, again, undergo "reconversion."

CHECK THESE POINTS

for Triad Emulsion Cleaners

Triad Emulsion Cleaners quickly and easily remove buffing, lapping and drawing compounds, as well as magnaflux, in metal parts washers or still tanks. In addition, temporary rust protection of metal parts between machining is provided.

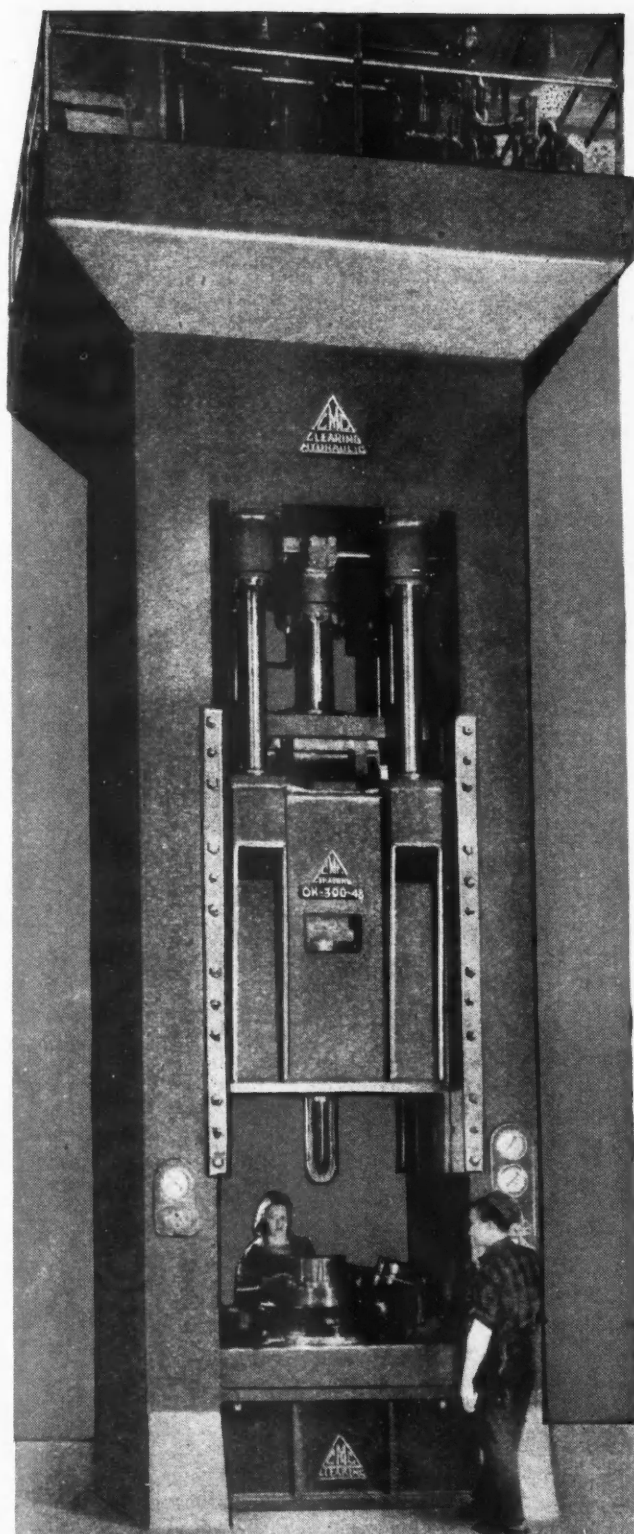
These TRIAD EMULSIONS are only a part of the complete line of Detrex water-soluble cleaners. A case history file of unusual cleaning procedures is available either by home office or local inquiry.



DETREX CORPORATION

DETROIT, MICHIGAN

A-109



DEEP DRAW

To Meet Rigid Specifications

True test of the soundness of press design is found in deep drawing operations . . . particularly those where wall thickness dimensions must be maintained to close tolerances. Travel of the ram must take place with extreme accuracy. The slightest deflection most often means rejected work.

In deep drawing operations like these, Clearing Presses have always excelled. Unsolicited letters of recommendation from shops throughout the nation bear testimony to the "something extra" of Clearing Press design and construction. Illustrated here is one type of Clearing deep drawing press . . . a 300-ton Hydraulic Four-Point-Suspension Press.

In addition to providing accuracy, Clearing can also always give the advantage of operating speed and ease. You are invited to write for the facts about Clearing Presses. An outline of your work requirements will permit us to make recommendations specific to your needs.

CLEARING MACHINE CORPORATION
6499 West 65th Street, Chicago 38, Illinois

CLEARING ★

**MECHANICAL AND
HYDRAULIC PRESSES**
FOR SUCH OPERATIONS AS DRAWING
+ BLANKING + FORMING + FORGING

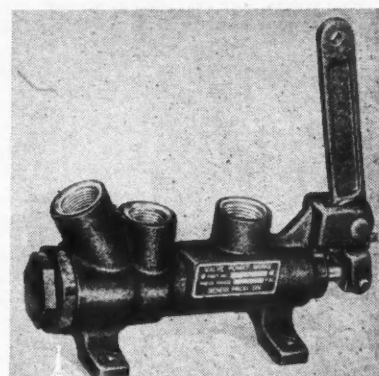
New Products for Aircraft

Hydraulic Power Brake Valve for Aircraft

Announcement of a new hydraulic power brake valve for use on airplanes was recently made by Bendix Products division of Bendix Aviation Corp. at South Bend, Indiana.

On airplanes a hydraulic pressure

system is provided with pump and accumulator which gives hydraulic power for actuating various controls of the airplane including the landing gear brakes. The pressure in such systems may run as high as 3,000 psi, making it necessary to provide a special means of reducing this pressure before it is transmitted to the wheel cylinders in



Bendix universal power brake valve

the brakes, which usually operate at hydraulic pressures ranging from 150 psi up to 1,000 psi maximum. The Bendix valve acts as a reducing valve and at the same time provides graduated control of brake action in response to operation of a foot pedal by the pilot.

With this new Bendix valve all the pilot does with physical power is to actuate the valve; hydraulic pressure originating from a high pressure pump does the work of brake application for him.

Cold Starting Fuel

A cold starting fuel for aircraft operating in subzero temperatures has been brought out by The Texas Co. It is designed to replace high octane gasolines for only the brief interval required to start.

The fuel is used in regular aviation carburetor and priming systems. A portable external tank or bottle is attached to regular fuel lines, shutting off main fuel lines and allowing the special fuel to flow for about two minutes. After engine is warmed up, the portable external tank may be disconnected by ground crew, and the engine then draws its fuel from regular gasoline tanks. The cold starting fuel is liquid at all atmospheric temperatures and can be shipped in regular containers.

Strong, Lightweight Construction Material

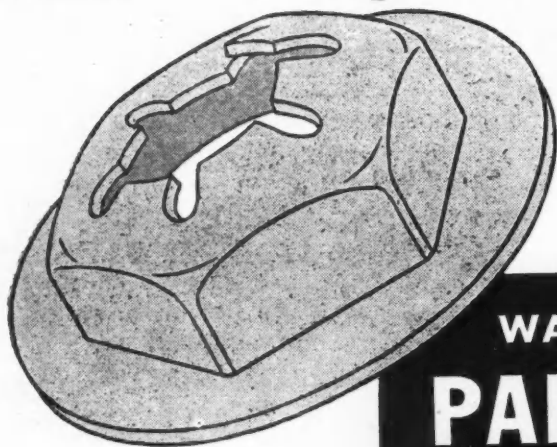
A lightweight construction material of great strength has been developed by the United States Plywood Corp., New York, N. Y., and the Glenn L. Martin Co., Baltimore, Md.

Made of a newly-developed "honeycomb" of cloth or paper sandwiched between and firmly bonded to thin sheets of aluminum, stainless steel, wood veneer or plastic, the new, waterproof sheets are said to be structurally far stronger than anything at the same weight now being manufactured. It was the development of a practical manufacturing method of bonding the metal or veneer sheets to the honeycomb which made the product possible.

The honeycomb may be made of paper, cotton cloth, fiberglass, or linen, (Turn to page 96, please)

Speedy, Low Cost Fastening

OF
MOULDING STRIPS
HOOD & TRUNK
MEDALLIONS
TAIL AND
PARKING LIGHTS
ETC.



WASHER TYPE
PALNUTS

Handle **ONE** part



instead of **THREE**



THESE inexpensive one-piece, self-locking Palnuts perform the same function as regular nut, lockwasher and plain washer combined. You not only replace three parts with a single Palnut, but power drivers may be used to further speed up assembly. Special sockets for power drivers pick up, spin on and tighten Palnuts in one operation. Once

tightened, Palnuts stay tight under vibration—assured by their exclusive double locking spring action.

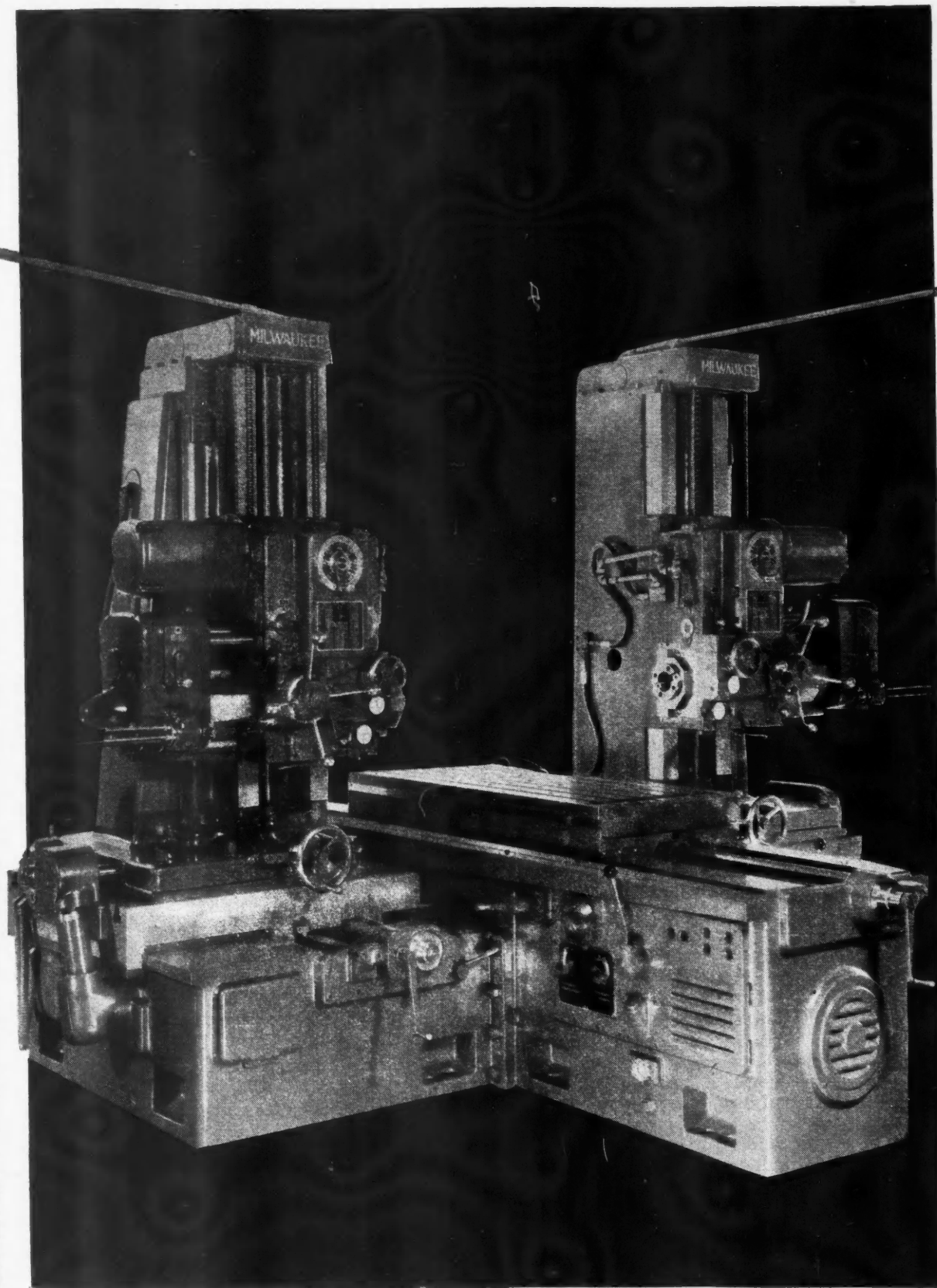
Send for samples. Ask for engineering literature on entire Palnut fastening line.

THE PALNUT COMPANY

60 Cordier St., Irvington 11, N. J.



Self-Locking PALNUTS



KEARNEY & TRECKER
MILWAUKEE

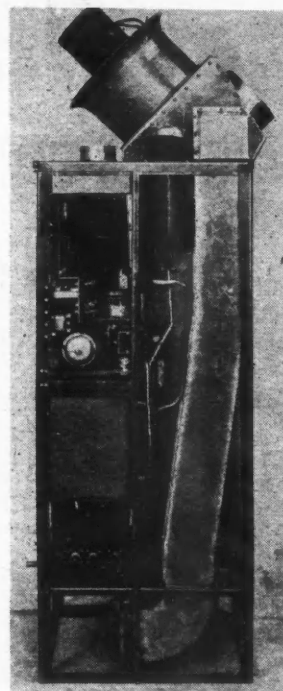
Precision Milling and Boring Machine
No. 3 MODEL TT

impregnated before the core is formed with a phenolic resin. Weight of the core material used can be varied to conform to the stress or weight which the finished product will be required to carry. Type of facing and thickness will also vary with the load requirements. Various aluminum alloys, stainless steel, wood veneers and plastic sheets can be used either singly or in combination. When no heavy strains are to be placed on the panel, the wood veneer can be applied directly to the honeycomb. Thickness of the core may be from $\frac{1}{8}$ in. upward and sheets as large as 7 by 30 ft have been made

by the Plywood Corp. Eventual size is limited only to the size of the skin material or size of presses. Weight of the core can be as little as four lb per cu ft.

Heating Package for DC-3 and C-47 Airplanes

A complete heating package for use in DC-3 and C-47 airplanes converted to commercial use is now in production at the Columbus, Ohio, plant of Surface Combustion Corp., Toledo, Ohio. The heating package contains a Janitrol whirling flame aircraft heater with a



Aircraft heating package made by Surface Combustion Corp.

rated output of 100,000 Btu and a maximum output of 125,000 Btu when installed in a DC-3. The package also contains a fuel pump, high-voltage spark ignition system, ventilating and combustion air blowers, thermostatic temperature controls and other component parts.

The complete heating unit fits into the DC-3 baggage compartment at either station 136 or 177, its overall dimensions of 12 in. by 15 in. by 49 in. occupying but approximately 5.2 cu. ft. Its weight is approximately 100 lb including blower for ground operation.

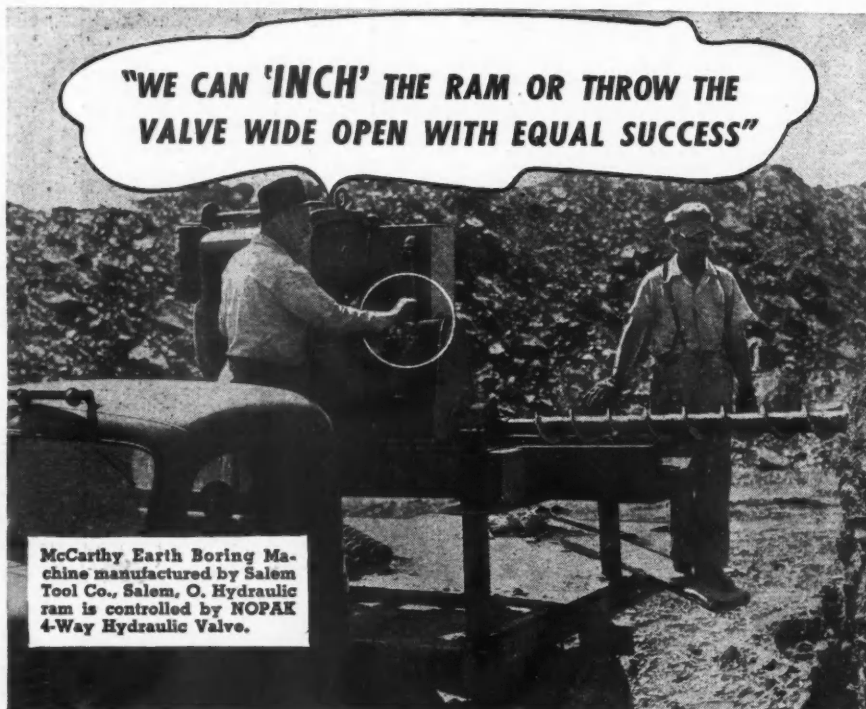
Smoke Detector for Airplane Cargo Space

A smoke detector for airplane cargo space which works on a standard 12, 16, 24 or 28 volt circuit and utilizes a photo-electric cell is a recent development of Walter Kidde & Co., Inc., of Belleville, N. J.

The Kidde light intercepting type of detector has a light directed on a photo-electric cell with clear air between the cell and the light source. The action of this light controls an electric circuit. The introduction of smoke into the light path reduces the light intensity reaching the cell and unbalances the electric circuit. Either audible or visible alarms are set off by this action.

Packaged Horsepower for Douglas DC-4 Airplanes

A new Cyclone power-unit installation for the Douglas DC-4 is announced by the Wright Aeronautical Corp. The power unit was designed by Wright as
(Turn to page 98, please)



McCarthy Earth Boring Machine manufactured by Salem Tool Co., Salem, O. Hydraulic ram is controlled by NOPAK 4-Way Hydraulic Valve.

A manufacturer of earth-boring machines has found NOPAK 4-way Hydraulic Valves ideally adapted to the strenuous work performed by this equipment. Here is a quotation from his letter:

"—we want you to know that the NOPAK $\frac{3}{4}$ " and 1" 4-way throttling valves — have proven the best obtainable . . . In behalf of the valve, we have found it will operate the ram smoother than other valves; that we can 'inch' the ram or throw the valve wide open with equal success".

This letter emphasizes a NOPAK Valve feature that is important in most applications: Namely that the NOPAK principle provides positive control through the complete cycle of valve operation . . . slow gradual throttling action or opening to full pipe area, without shock to the equipment. Consider this feature when you specify operating valves for air or hydraulic equipment. Literature on request.

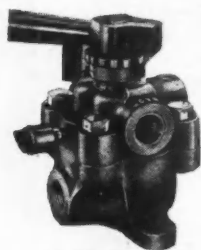
GALLAND-HENNING MFG. CO. • 2774 S. 31st ST., MILWAUKEE 7, WIS.

NOPAK

VALVES AND CYLINDERS

DESIGNED for AIR and HYDRAULIC SERVICE

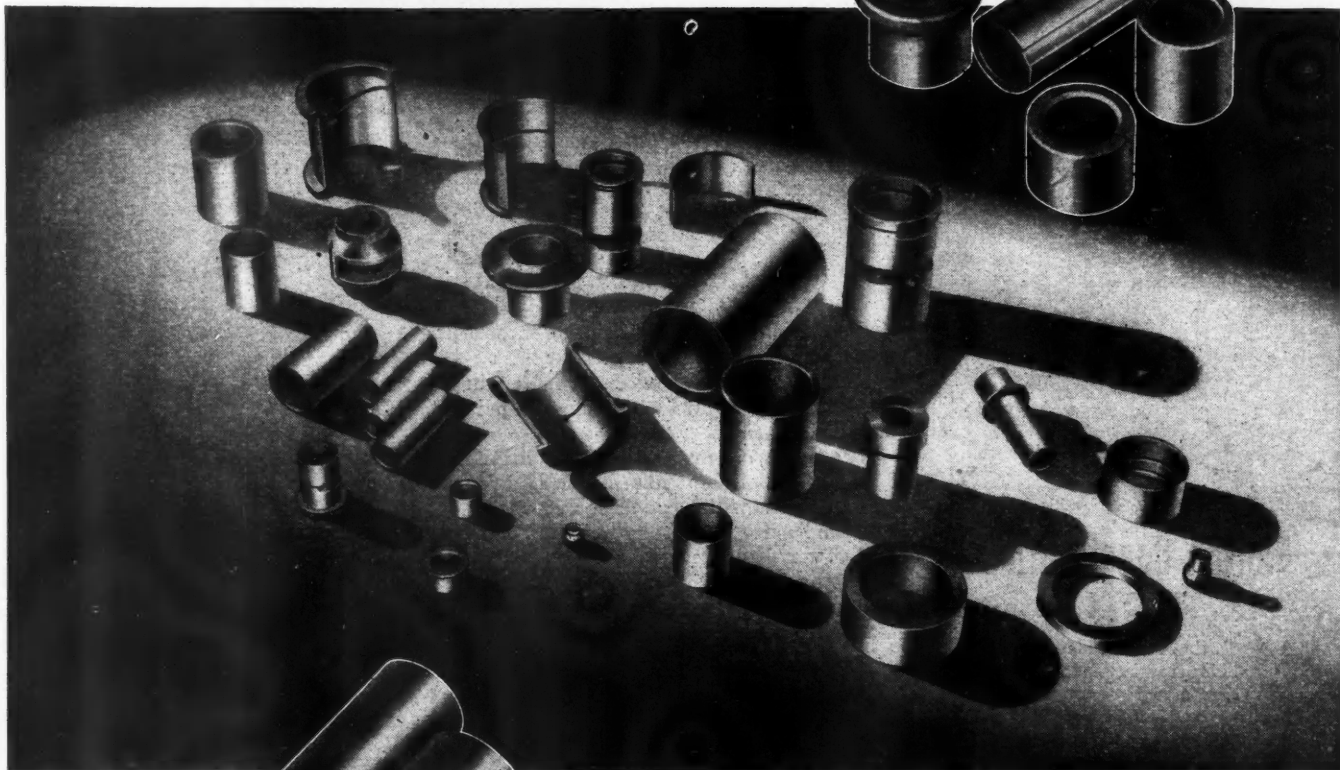
A 4949-1/2I



NOPAK 4-WAY HYDRAULIC VALVE

NOPAK 1 inch 4-way Hydraulic Valve for water or oil service (up to 300 P.S.I.). Has stuffing box with packing gland nut to prevent spindle seepage. Available with either closed or open center cycle.

Silent Partner



of Performance

QUIET operation is a strong selling point in any type of equipment. One easy way to eliminate noise is to install Johnson Bronze Sleeve Bearings in the motive units. Every Johnson Bearing is precision made, guaranteed to deliver the utmost in performance for the longest period of time.

The easiest way to determine the correct type of Sleeve Bearing to use is to call in a Johnson Engineer. Permit him to review your applications . . . to make recommendations, based on facts, free from prejudice. Remember . . . only Johnson Bronze makes **EVERY** type of Sleeve Bearing. There is a Johnson Engineer as near as your phone. Why not call him in—**TODAY?**

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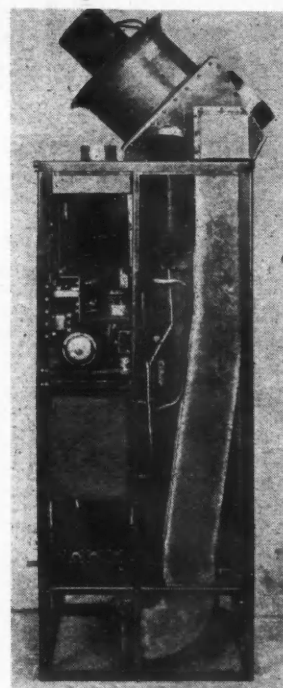
BRANCHES IN
18 INDUSTRIAL
CENTERS

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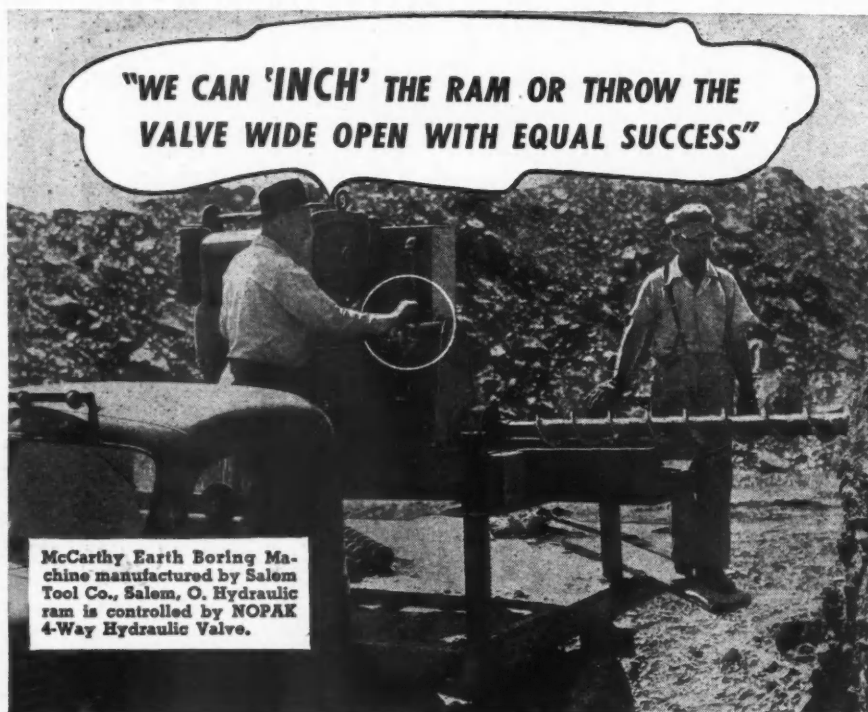
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NOPAK
VALVES AND CYLINDERS
DESIGNED for AIR and HYDRAULIC SERVICE

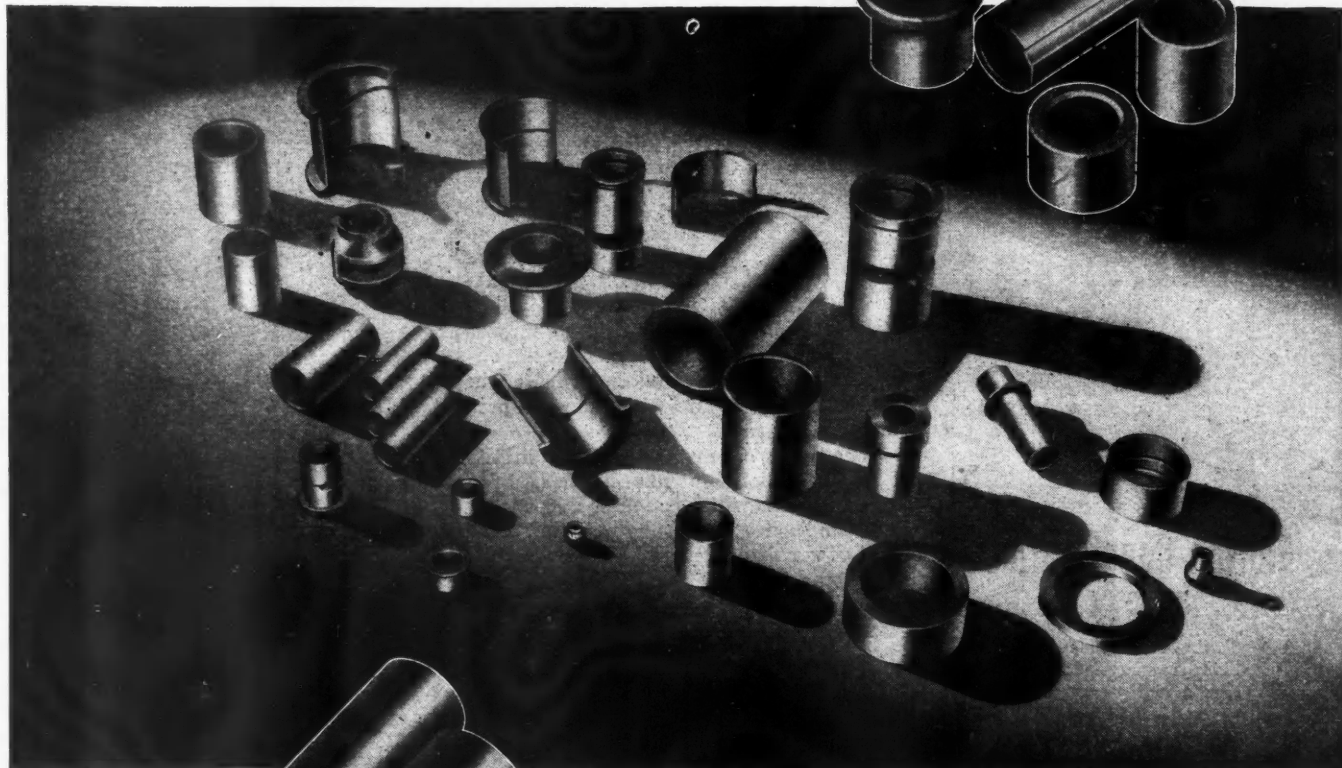
A 4949-1/2I



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NOPAK 1 Inch 4-way Hydraulic Valve for water or oil service (up to 300 P.S.I.). Has stuffing box with packing gland nut to prevent spindle seepage. Available with either closed or open center cycle.

Silent Partner



of Performance

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a means of "packaging" higher horsepowers for the DC-4 without modifying the frame of the airplane in any way.

To be produced with the cooperation of the Rohr Aircraft Corp., Chula Vista, Cal., the unit consists of the Cyclone 9HD air-cooled engine, equipped with a pre-fabricated nacelle that attaches directly to the present DC-4 wing and firewall.

More powerful than the 1,350-hp engines used in the DC-4 up to this time, the Cyclone 9HD power plants in the new unit, which develop 1,425 takeoff hp each, will increase the cruising speed of the plane to approximately 265 mph at only 60 per cent of power for a gain of nearly ten per cent. The cruising rate, thus, becomes almost the same as the old top speed.

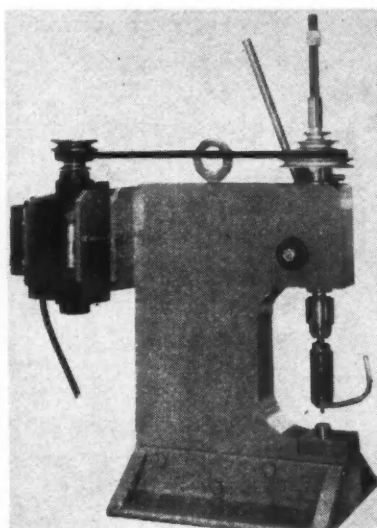
Bendix Personal Plane Radio

A two-band aircraft radio receiver weighing only 4½ lb including power supply and shockmounts, marks the entry of the Radio Division of Bendix Aviation Corp. into the field of personal plane radio.

The PAR-70, first equipment in the Flightweight line of low-cost radios for light planes, will provide for reception of broadcasts, radio range signals, control tower directions, and—when a loop antenna is added—allows aural-null homing as an aid to navigation.

(Turn to page 100, please)

Special Yoke to Operate Topflight Spin Dimpler



This special yoke was designed and built by Topflight Tool Co., Towson, Md., for operating the company's Spin Dimpler that forms dimples in aluminum and magnesium alloys by spinning, rather than pressing or pounding them into the metal. The spin dimpling method is said to produce dimples that are free of cracks and have sharp corners at the face of the sheet.

(Advertisement)

HANGAR FLYING



6 Designs for a Windshield

The people in the Engineering Research building at Lockheed, Factory B-1, Burbank, point out that the unique windshield design on the *Constellation* didn't just happen. Five experiments preceded it.

Windshield No. 1 went into a completely faired nose. It looked good on paper, but when it was mocked up Lockheed found that vision for pilots was bad.

Type 2 was an attempt to put the crew "downstairs". This turned out to be a failure because it would have been pretty uncomfortable in a belly landing. This is the way it looked:



The engineers next tried two small bug-eyes, which were successful only in giving the crew claustrophobia. Discard No. 3:



A wide, single bug-eye type was tried next, but was found difficult for pressurization.

Fifth was a conventional "Vee" windshield, but the fuselage was too big to allow for an effective design.

The sixth windshield was adopted. Besides being the lightest of all, its many small panels give excellent vision angle as well as convenient control and instrument arrangement.

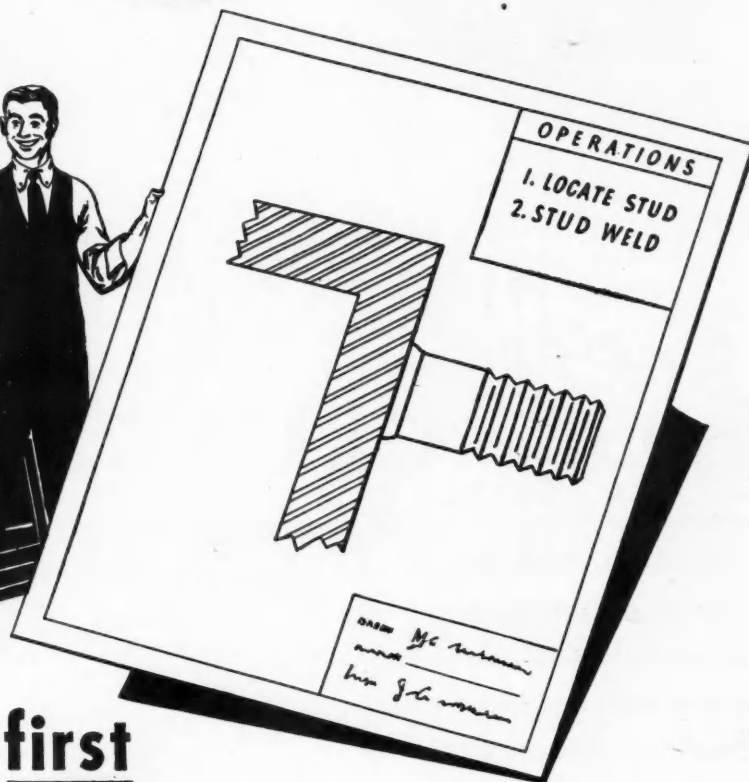
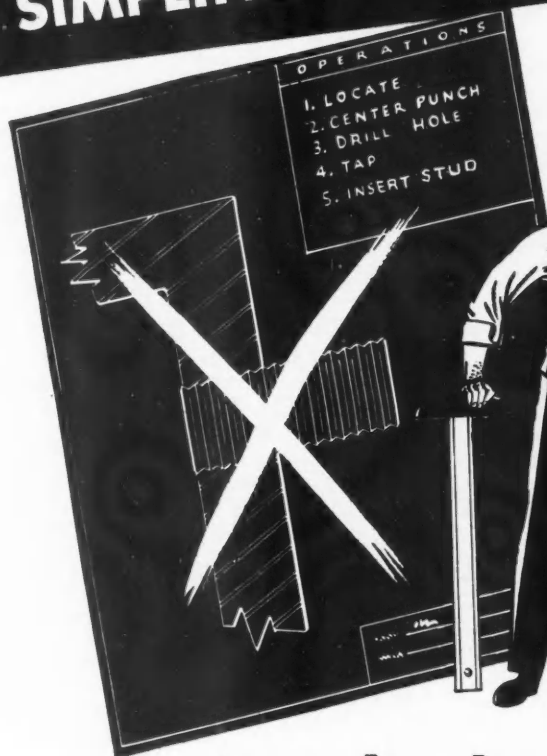


This kind of inspired persistence is going on all the time at Lockheed—the kind that makes good planes and good telling.

L to L for L

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SIMPLIFIED DESIGN



... is only the first of NELSON Stud Welding advantages!

The first place you'll see the advantages of NELSON Stud Welding is on the drawing board. With no drilling or tapping required to install studs the NELSON way, design is simpler and production drawings require less detail. Because the NELSON manual stud welder is as portable as an electric drill, you can design for many stud installations on large units *after* erection or assembly at no premium in production cost.



NELSON Stud Welding speed (100 to 200 studs per hour can be welded manually, 20 or more studs per minute with production models) plus the

elimination of punched or drilled holes, tapping, or hand-welding, can step up production and show substantial savings in cost.

Complete information on NELSON manual and production welders, the wide variety of NELSON flux-filled stud types and sizes available, and scores of representative applications are contained in the new NELSON catalog. A copy is yours for the asking—write today!

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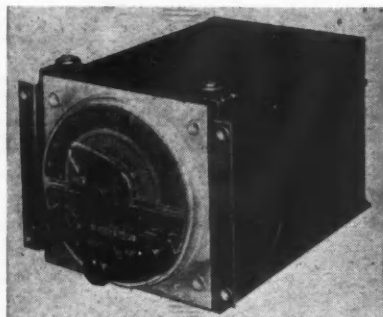
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STIRRUP



FEMALE



Bendix PAR-70 radio receiver

The new Bendix receiver and self-contained power supply is 4 5/16 in. high, 5 3/16 in. wide, 7 in. deep. Both loudspeaker and headphones may be used with equal efficiency.

The frequency range extends from 200 to 400 kc, and from 550 to 1500 kc. On the 200 to 400 kc band, this diminutive receiver picks up airport control towers, civil airway stations, and range stations. The other band provides for reception of the regular broadcast programs for entertainment or navigation.

Design and Tooling Aspects of the Ryan

(Continued from page 27)

tion was complex. After considerable discussion on the merits of the various types of tools, it was decided to provide final assembly tools first. These final assembly tools might be termed the mating fixtures for subassemblies, and are not to be confused with the final assembly of the airplane. For example, in the case of the center section, an assembly fixture was provided in which the complete center section could be built.

In this case the fixture was provided with the necessary contour forms for the location of the leading and trailing edges of the wing. The locating fittings for the wing attachment points as well as the wing-flap hinge brackets and other critical points were also part of this center section assembly fixture.

It is obvious that this tool would not be suitable for the production of any large quantities of assemblies. It would, however, provide a fixture which would permit the construction of a few assemblies. These assemblies could be located properly and held accurately at all critical points. Later, the tool could be fitted into the final production tooling.

The four-point suspended type of fixture demands a mounting comparable in stability and accuracy to the tool itself. The solid foundation required for it is not necessarily a concrete floor but one which will in no way affect the fixture and its critical locating points. While it has been common practice in the construction of large assembly fixtures to employ the use of reinforced concrete, many large fixtures are based on a regular concrete floor. This is normally satisfactory providing the floor is sufficiently strong. There are, however, definite problems connected with this arrangement in some locations. The case of a factory which is built on filled ground and situated very near the ocean where actual floor changes result with the changing of the tide would be an example of this.

At Ryan in San Diego this condition exists, and in order to eliminate this, and other specialized tooling problems, the construction of assembly fixtures has been changed from those using the concrete floor as a base, to three-point support fixtures which are entirely independent of the floor. This type of fixture is not affected by changes created by movements of the floor.

In order to utilize this idea it was necessary to provide a base for the fixture, designed in such a way as to be self-supporting. It had to be rigid and strong within itself, and be capable of only a minimum amount of deflection. It was found that the most logical and suitable material available for building these fixtures was tubular sections,

(Turn to page 102, please)

Specify **ROCKFORD** — SPRING LOADED — for **CLUTCHES**

LIGHT PEDAL PRESSURE

CUSHIONED ENGAGEMENT

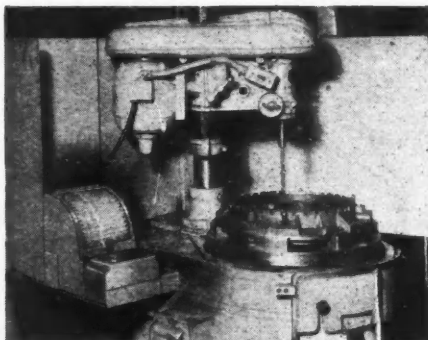
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ACCURATE BALANCE *

DIRT EXCLUSION

HEAT DISSIPATION

LIFETIME ADJUSTMENT



* All ROCKFORD Spring-Loaded CLUTCH plates not only are carefully checked for accuracy of dimensions and flatness but are electronically inspected, on this special machine, to make sure that each has correct dynamic balance. Uniform operation, minimum wear, less-frequent adjustment and long life qualities of ROCKFORD Spring-Loaded CLUTCHES thus are protected during production. These quality safeguards help insure low maintenance, after the clutch is installed.

SEND FOR THIS HANDY BULLETIN ON POWER TRANSMISSION

It shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications. Every production engineer will find help in this handy bulletin, when planning post-war products.



ROCKFORD CLUTCH [FORMERLY KNOWN AS] DIVISION

BORG-WARNER CORPORATION

315 Catherine Street, Rockford, Illinois, U.S.A.



REDUCE DEAD-WEIGHT—

INCREASE PAY LOAD WITH

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Otiscoloy high tensile steel sheets offer the design engineer new opportunities to eliminate bulk and dead-weight in new products. With 50,000 P.S.I. minimum yield point, 70,000 P.S.I. minimum tensile strength, 25% elongation in two inches, Otiscoloy is ideally suited for many

applications. Otiscoloy resists corrosion, abrasion and has excellent weldability. It forms hot or cold. J&L Otiscoloy is now available in sheets, strips, plates, Jal-Tread floor plate, Junior Beams, Junior Channels, Electricweld tubing and hot and cold finished bars.

JONES & LAUGHLIN STEEL CORPORATION

PITTSBURGH, PA.

February 15, 1946

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METAL SPOKE WHEELS • GEARS AND FORGINGS • RAILWAY TRUCKS

such as oil well casings. These were available in different sizes, were strong, rigid and well suited in jig and fixture construction. Since initial use of this type of fixture construction, other types and shapes of material have been used with success. The round tubing, however, has proved satisfactory in the majority of cases.

This tolerance is attained by first welding to the frame-work the required angles and attaching plates to mount holding devices and locating points; 1/16 in. to 1/2 in. space is allowed between the base plates and the fixture attaching angles. The problem of whether or not to normalize the fixture after all welding is completed on the frame-work in order to release welding strains has been studied carefully, and occasionally flame normalizing on large assemblies has been found advisable. In cases where fits and tolerances of all joints are close, the welded seams may be hammered after welding. In most cases the fixture will have stopped shrinking by the time it is necessary to finally establish the locating points.

A Jig Builder's Transit is used in setting up and establishing center lines and locating points because of the great saving in time which it provides. The old time-consuming method of stringing horizontal and vertical wires has long since been abolished. It is interesting to note that where the old method required from six to eight hours, it now takes approximately 20 minutes to do the same job. It is important that the Transit be designed to work to close tolerances at short ranges.

All of the critical holding devices and locating points can be installed after the framework is complete. After these holding devices and locating points are satisfactorily checked and inspected, the spaces adjacent to them are filled in with cerromatrix to permanently locate them.

Detergent Oils

(Continued from page 29)

master rod bearing deposits were also softer and less brittle with very little "flaking off" in evidence. The cam rings of three of the four engines on the compounded oil were clean as compared to a light varnish in the case of the straight mineral oil. Sludge deposits in all of the engines operated on the detergent oil were less than in the engine operated on the straight mineral oil, the average sludge demerits being 0.9 and 2.1, respectively. This improvement was noted on the crankshaft, where sludge had been almost eliminated, on the cylinder skirts and in the center and rear sections of the crankcases.

It is of interest that the individual engines operated on a given oil gave about the same deposit demerit ratings.

(Turn to page 104, please)



LONG

CLUTCHES • RADIATORS • OIL COOLERS

Pattern for Cooling Efficiency

Since 1903, Long has built radiators for the automotive industry in the precise patterns required for highest cooling efficiency. Into every Long radiator—for car, truck, bus, farm machine—goes the knowledge gained in 42 years and the precise workmanship of Long craftsmen.

LONG MANUFACTURING DIVISION
BORG-WARNER CORP., DETROIT 12 AND WINDSOR

The detergent oil also resulted in a marked reduction in the amount of ring sticking and ring sluggishness observed at the conclusion of the two tests. Only one ring per engine was stuck, tight or sluggish with the detergent oil, compared to six per engine for the straight mineral oil. The mechanical condition of the two groups of engines was about the same, the average mechanical demerits being 0.39 and 0.36, respectively. These data are summarized in Table 3, while a more detailed comparison of ring sticking is given in Table 4. In these tests, combustion chamber deposits were somewhat heavier in those engines operated on the detergent oil

than in the corresponding engines operated on the mineral oil. However, there was no indication that these deposits were of sufficient magnitude to cause any difficulty.

Besides these tests, extensive flight tests were carried out in England, primarily at Operational Training Units, using the same type of aircraft and engines as employed for combat missions. The aircraft were usually operated under somewhat similar flight conditions to those which would be encountered during actual bombing missions, and in many cases the engines probably received even more severe treatment owing to the lower standard of experi-

ence of the crews. It is estimated that these tests amounted to about 75,000 flying hours, and since a good proportion of the aircraft were four-engined, this would correspond to approximately 200,000 engine flight hours. During the early stages of these flight tests, some foaming was experienced following the changeover to the detergent oil. This was minimized by adding the detergent oil gradually as make-up, rather than draining the mineral oil from the system and replacing with detergent oil. Examination of engines from these flight tests showed that (1) ring sticking was virtually absent, whereas with straight mineral oils it often occurred within 100 hr of operation, (2) piston ring groove deposits were less than with straight mineral oil, although overall engine cleanliness was not appreciably better, and (3) no adverse effect on ring wear or any of the bearings or bearing surfaces was noted.

On the basis of these service trials, the addition of Additive A to aviation oils was approved by the British for use in certain aviation engines. Since this approval was granted, these detergent oils have been widely used and very satisfactory results have been reported.

The following conclusions have been drawn from the extensive laboratory engine tests and flight tests carried out on oils containing a detergent-inhibitor additive.

1. The detergent oil minimized ring sticking and gave less piston skirt varnish, ring zone deposits and sludge than straight mineral oils.

2. The effectiveness of the detergent oil was dependent on engine type and operating conditions. Excellent results were obtained in high duty engines operating under severe conditions, particularly in air cooled engines having straight side rings. Less significant results were obtained in low or moderate power output engines.


3. In some cases the detergent oil had the undesirable effect of tending to increase combustion chamber deposits. Differences in combustion chamber deposits among engines are considered to be due in part to variations in the degree of turbulence within the combustion chamber.

4. The foaming characteristics of the detergent oils on which data were obtained are essentially the same as those of a straight mineral oil.

5. The good performance of the detergent oil under high duty, high temperature conditions indicates that it may be an important factor in the future development of improved aircraft engines.

Dr. Moss Honored by IAS

Dr. Sanford A. Moss, General Electric consulting engineer famed for his pioneer work on airplane superchargers, has been elected a Fellow of the Institute of the Aeronautical Sciences.

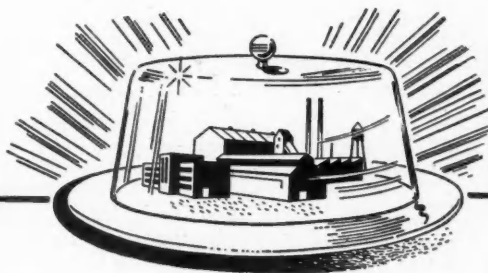


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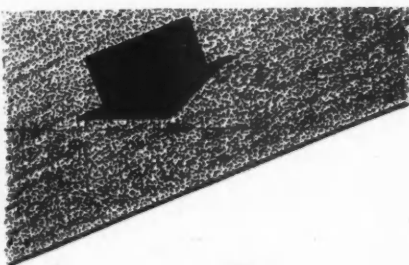
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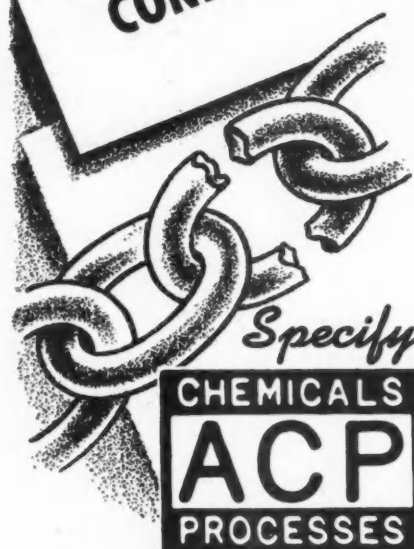
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Milling Spar Caps

(Continued from page 34)

them into tote boxes.

Spar milling has proved very economical for experimental work even for one or two pieces. The raw material is attached to the machine bed with standard machine shop clamping devices whenever practical. Masonite form bars are economical and satisfactory for a small quantity of parts. The 60-ft bed spar mill in our experimental plant is busy most of the time, not only on spar caps but also for milling large stringers and other similar parts.

Good Hard Sense

(Continued from page 15)

ward to higher living standards. Industry's profits should bring (1) wage increases; (2) price reductions; (3) reward for management as an incentive to improve production. Also, reserves must be laid aside to buy the new machinery which will increase productivity and make further wage gains possible; and investors must receive enough return on their investment to bring your company adequate financing. You cannot expect all the profit to go into wage increases.

"Work to improve production per manhour, so there will be more income to share. Have an understanding with the company that workers are to share the increased income they produce and get higher wages.

"Secretary Schwellenbach's Rules for Fact-Finding Boards, issued Dec. 21, state that they may recommend a wage increase on the basis that it 'can be paid' by the company. To decide what increase 'can be paid' means deciding what profit a company should be allowed to make, what reserves it should be permitted to set aside against future emergencies or expansion, and similar policy questions. The government dictates policy, but will it guarantee a company against the losses which may result from carrying out that policy? This is dangerous tampering with private initiative. And labor knows that private initiative in America has brought the efficiency that makes possible high living standards."

Willys Distributorships in Foreign Countries

Distributorships in 70 foreign countries are reported to have been established for the marketing of the civilian Jeep and other Willys-Overland automotive products. The company's international sales organization is now more than 80 per cent completed and wholesale franchises covering the few countries still unassigned will be let within 60 days.

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In large-scale instrumentation such as Spicer's, Micromax's always helpful self-standardizing feature is a particular asset, saving in this case about one man-hour per day. This is in addition to its fundamental advantage of maintaining the full accuracy of the potentiometer's recording and control circuits.

Among the convenience features are the cell-condition indicator and a "tell-tale" which shows whether the instrument is in service. Ink and recorder chart warn well in advance when refills are needed. To communicate other information, "bull's-eye" or other signals can be automatically operated.

In addition to the two-position motorized control which Spicer uses, Micromax instruments can give control of proportioning or program types. The roomy Micromax case allows for extra equipment required for a complex control problem. And there's a model and range of instrument to match the need in any given application.



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New Sleeve-Valve Engine Revealed by Jack & Heintz

The long discussed sleeve-valve engine, which was known to be under development by Jack & Heintz, appeared to be closer to a complete disclosure with the showing of a prototype of a six-cylinder model at the National Aircraft Show held in Cleveland in January, 1946. The illustration was taken in a corner of the Jack & Heintz booth.

The engine as shown is not yet in production but represents the basic features of the line of horizontally opposed, six-cylinder sleeve-valve engines being developed at the present time.

According to the information available at the show, the six-cylinder model has a displacement of 126 cu in. and is rated, tentatively, at around 75 hp for automotive applications. An unusual feature, apart from design, is the development of intricate aluminum die castings for the engine structure. These are made in two halves, each one comprising a bank of cylinders and part of the crankcase. These die castings are said to be the largest and most intricate ever made in this country.

It is understood that the design lends itself to the manufacture of a water-cooled version if that is found desirable.



Jack & Heintz engine

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Recent Wage Increases

(Continued from page 46)

CIO moved in on the independents, and wage negotiations now are under way. Hudson and Packard have been bargaining the issue and it is thought that they will settle at approximately 18 cents an hour. Briggs Mfg. Co. also is discussing the issue with the union and probably will settle for about the same as Chrysler did, since the company usually follows the Chrysler lead. Nash had been served with a pay increase demand and is expected to meet the average figure of the industry—somewhere near 18 cents an hour. Studebaker, which granted an increase of 12 cents an hour last September, has an agreement with the union to meet the Detroit rate and doubtless will yield another 6 to 6.5 cents an hour.

Induced Air Flow

(Continued from page 31)

nect the bore of the rotor with a circular passage extending over two-thirds of the periphery of the rotor. As a slot passes the inlet, a slug of water is ejected into the circular passage and carried toward the discharge. This is followed by a slug of air, drawn into the circular passage by the water flowing over the edge of the rotor producing a depression by virtue of the induced flow effect. This slug of air is sealed in the circular channel by a slug of water introduced when the next slot is open to the channel. As a slug of air is carried around in the channel, it is further compressed by the increasing pressure of the water arising from the centrifugal action. The water and air are discharged into a diffuser, which terminates the circular channel, from which they are discharged into a separator where the water falls to the bottom and the air discharges through the outlet provided. Strangely enough, it has been reported that there is no change in flow if the pump is rotated backwards, allegedly due to the induced flow effect at the edge of the slot.

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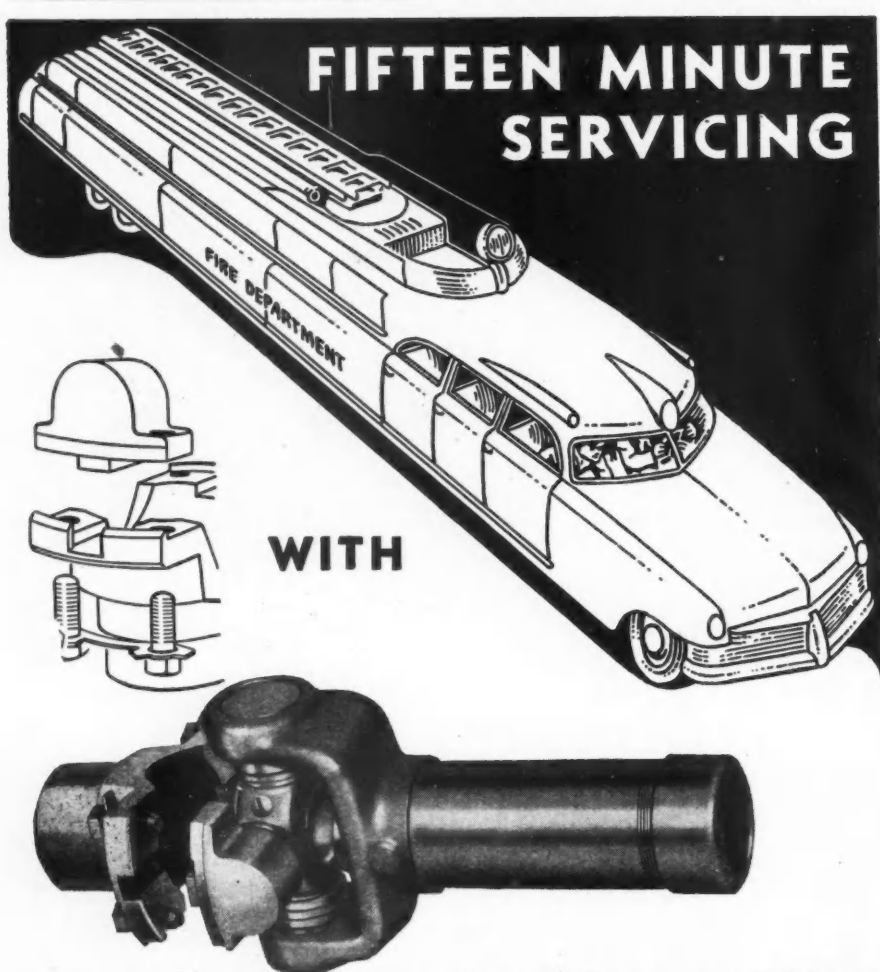
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Small Engines

The first interesting motor car engine to be built for a long while and, I hope the forerunner of some really modern engines for motor cars, is the Crosley. Many of the design features of this wonderful little engine will, in my opinion, later be found in light aircraft engines. It is interesting to note that a maker of plane engines who has

made aircooled radials exclusively is coming out with a small liquid-cooled engine to compete with the popular group of four cylinder opposed air cooled jobs. While I have always favored air cooling I will readily admit that liquid cooled engines are less liable to be damaged by careless or stupid operation than the air cooled engine and a light liquid cooled engine should be very successful.



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MECHANICS Roller Bearing UNIVERSAL JOINTS can be removed and replaced — on the road — in fifteen minutes — with a wrench and screwdriver. Worn flange-type bearing assemblies can be lifted out simply by removing two screw bolts. Let our engineers help you design MECHANICS Roller Bearing UNIVERSAL JOINT applications that will give your new models this and other advantages.



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Fear

If you ask most people what passion governs most of the actions of the human animal they will answer "greed." This is wrong because most of what we know as greed is basically fear. It is fear which has held aviation back more than any other factor with cost a close second. I get about by plane quite a bit and I believe that the big four-engined jobs will do away with much of the fear element. Recently I flew into a rather rough spot on one of the good old DC-3's and almost immediately afterwards in one of the really big jobs and the difference was amazing. The big job went through that rough air with almost no apparent motion and none of the quick changes of attitude and altitude so distressing to the timid person on his or her first ride.

Giving Away Business

During the first part of the war the airlines gave far more courteous booking service than the railways and their planes held their schedules fairly well. Lately I was forced to take a trip making connections between different airlines and I never saw such a mess of handling traffic. Our plane with several passengers holding seats on the other job came in before the connection left, but the second airline sold our reservations as "not called for in time" regardless of the fact that our plane was late. They explained that they did not take any dictation from any other line as to the holding of reservations nor did they find out if the people holding the reservations were actually on the other plane. With all of the radio communication and careful scheduling of flights through the control tower such an attitude is inexcusable and simply turns people against air travel. In this case the delays made a 400 mile trip by air take more time by air than it would by motor car. Nowhere was there the slightest sign of competence on the part of the booking desk crew. Further, a 54-passenger plane was held for two hours with passengers waiting for no apparent reason and with no explanation other than promises that it would leave in 10 minutes. If airlines continue this kind of operation the deluxe railway train will take much potential air traffic.

Speed

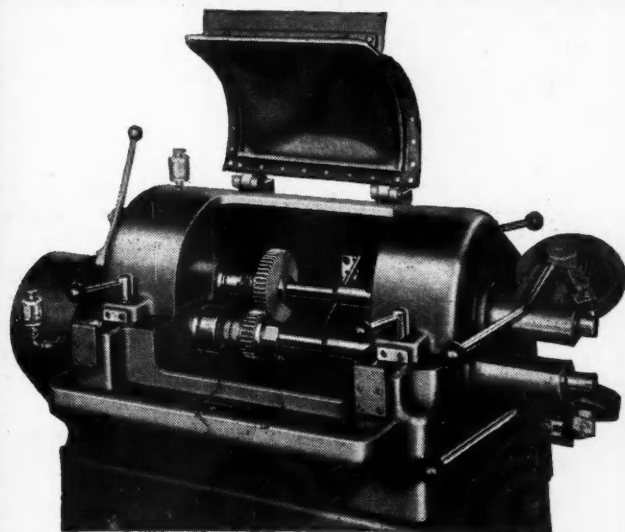
The four-hour and fourteen-minute west-east crossing of the Continent shows what the newer types of aircraft can do and remember that every time a fighter craft has made a speed record it has soon been equalled by a big airplane suitable for passenger carrying.

Don't Let NOISY GEARS Reach Assembly

There is no excuse for incorporating noisy gears in any assembly where gear noise cannot be tolerated. Find out before those gears reach assembly whether or not they are noisy and avoid the necessity of tearing down the assembly in order to replace them with quiet gears.

That is precisely the function of The Red Ring Gear Sound Tester. It will always spot noisy gears. Furthermore, it will indicate the nature of the trouble which causes the noise so that it can be corrected.

The acoustical horn of this machine amplifies gear noise 50 times. Center distance between gears in the sound chamber may readily be set with precision gage blocks. Gears may be tested either with or without brake load.



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Douglas Receives Large Order for Dive Bombers

A new dive bomber whose maximum speed is said to be at least 50 mph faster than any wartime dive bomber or torpedo plane has been developed by Douglas Aircraft Co., Inc. The Navy has ordered \$50 million worth of the planes which are now in production at the company's El Segundo plant.

The BT2D-1 is both dive and torpedo plane, with a range in excess of 1500 miles, a bomb-torpedo-mine load of 6000 lb, battery of five-in. rockets and 20 mm machine guns in the wings, the Navy disclosed.

Although a heavy-load carrying bomber type, the BT2D-1 has exceptional maneuverability and rate of climb, while in vertical dives from service ceiling it has reached true speeds in excess of 500 mph, Douglas engineers report.

The new dive-bomber is equipped with fuselage dive brakes, an innovation said to embody the first production application of this principle. In addition to important aerodynamical advantages, this new device affords the equivalent retarding effect of conventional trailing edge wing flaps with less than 80 per cent of the brake area previously required, the company states.

The power unit is a single Wright R-3350 radial engine, delivering 2500

hp at take-off 2900 rpm. A four-blade Aeroproducts propeller 13½ ft in diameter furnishes propulsion. The ship is 39 ft long and weighs 10,470 lb, minus useful load.

Personals

(Continued from page 50)

Gen. Mgr., Tire Manufacturing Div.

The B. F. Goodrich Chemical Co., John R. Hoover, elected Vice-Pres. in Chg. of Sales. Allyn I. Brandt, Gen. Sales Mgr. of all Chemical Company Products.

The Goodyear Tire & Rubber Co., Ralph W. Sohl, Farm Tire Development Mgr., succeeding Elmer F. Brunner, deceased.

Allied Control Co., Inc., Lewis A. Jones, elected a Vice-Pres.

The Lithium Co., Morris D. Utley, New England District Sales Mgr. A. F. Tenney, Southern Ohio District Sales Mgr.

F. L. Jacobs Co., Joseph H. Briggs and C. E. Sorenson, elected directors.

The National Screw and Mfg. Co., Benj. H. Jones, Asst. Vice-Pres. and acting Genl. Sales Mgr.; Charles W. Baker, Mgr. of Technical Sales; Harold W. LaGanke, Mgr. of Distributor Sales; A. L. Murdoch, Asst. Sales Mgr. and Chas. L. Kerr, Asst. Sales Mgr.

Lindberg Engineering Co., Lt. Robert S. Atchison, in charge of Adv. Dept.

General Box Co., N. A. Fowler, Vice-Pres. and Director of Research will succeed E. E. Ames as Director of Sales and Research. Mr. Ames will retire July 1st.

Alloy Rods Co., Gustaf A. Ostrom, Chief Research Engineer.

Arcos Corp., R. David Thomas, Jr., elected Vice-Pres.

Advance Pressure Castings, Inc., Fred J. Tobias, in chg. of production and metallurgy.

L. C. Allman, Vice-Pres., Fruehauf Trailer Co., elected Chairman of the Board of Directors, Truck Trailer Mfg. Assoc.

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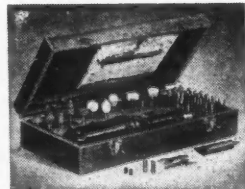
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